THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXII. No. 1858.] LONDON, DECEMBER 20, 1898. [50TH YEAR. PRICE 6d.

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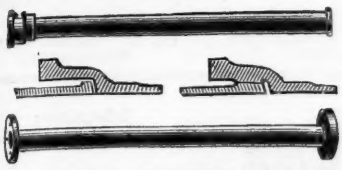

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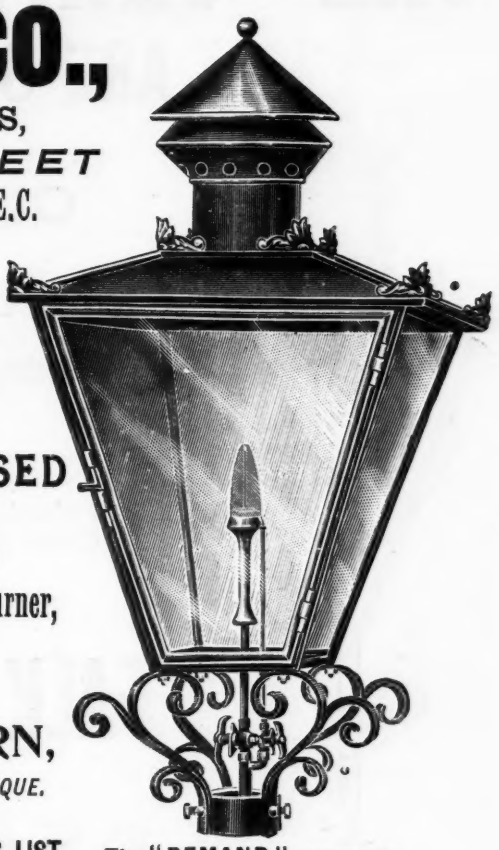

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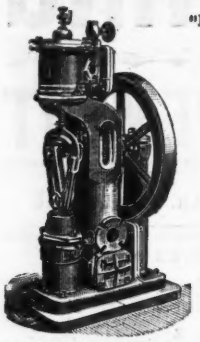

Fig. 706. "SINGLE RAM" STEAM-PUMP.

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

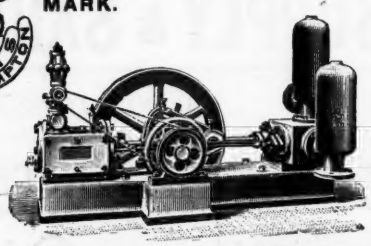

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

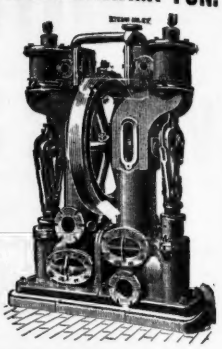

Fig. 712 "DOUBLE-RAM" STEAM-PUMP.

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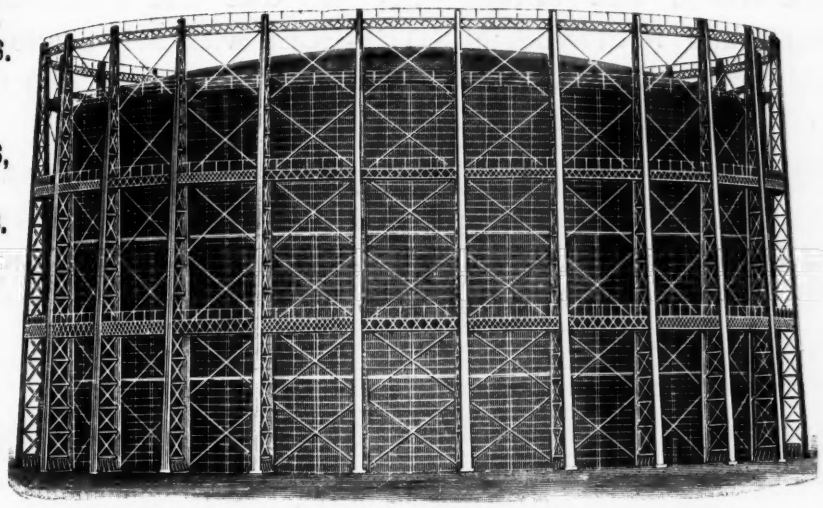

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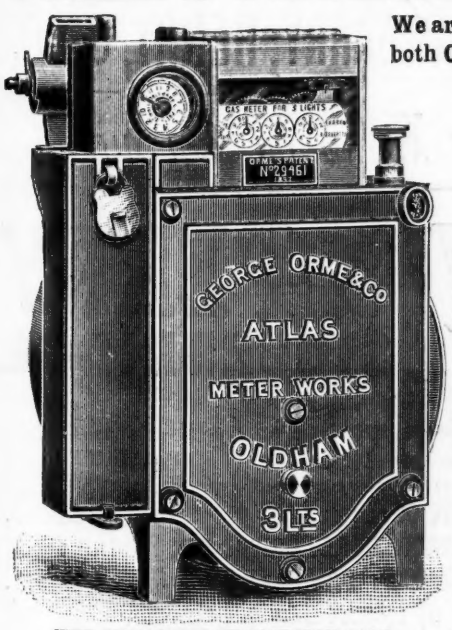

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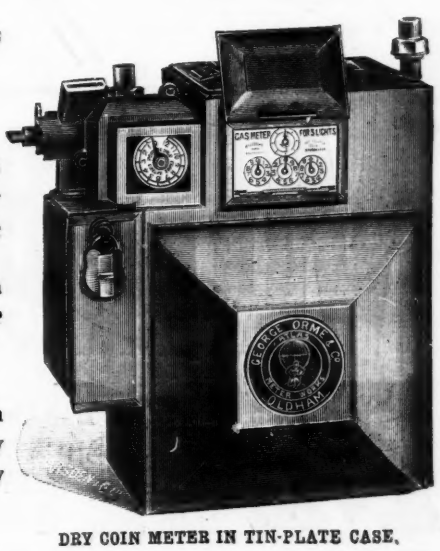

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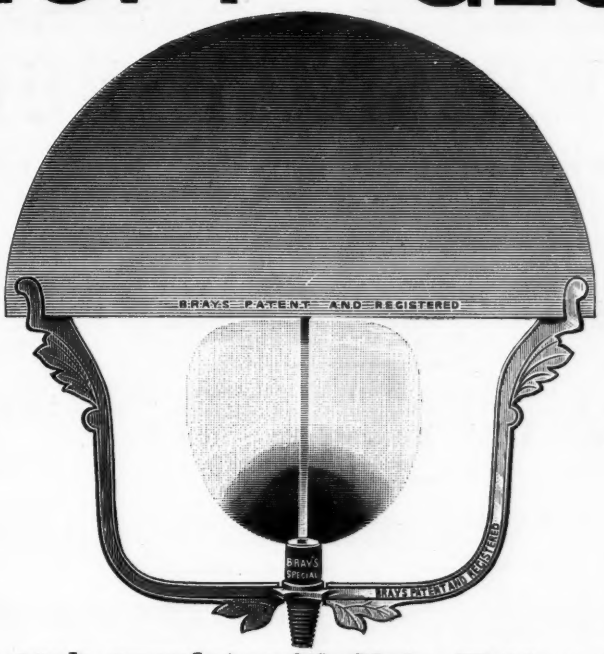

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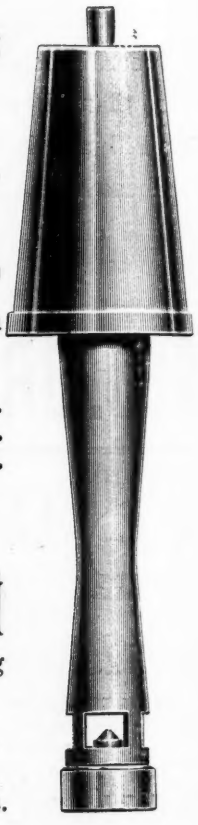

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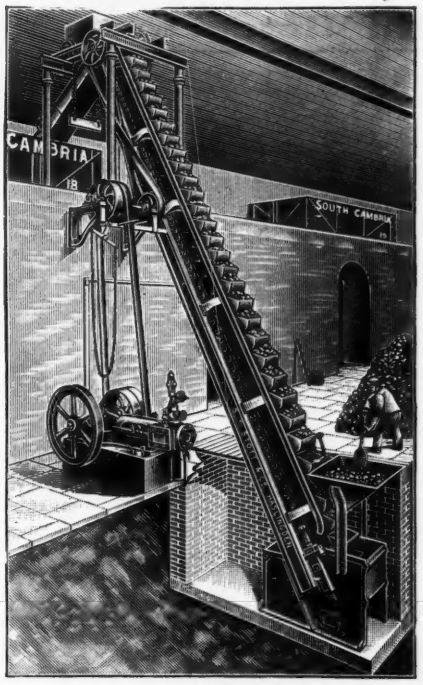

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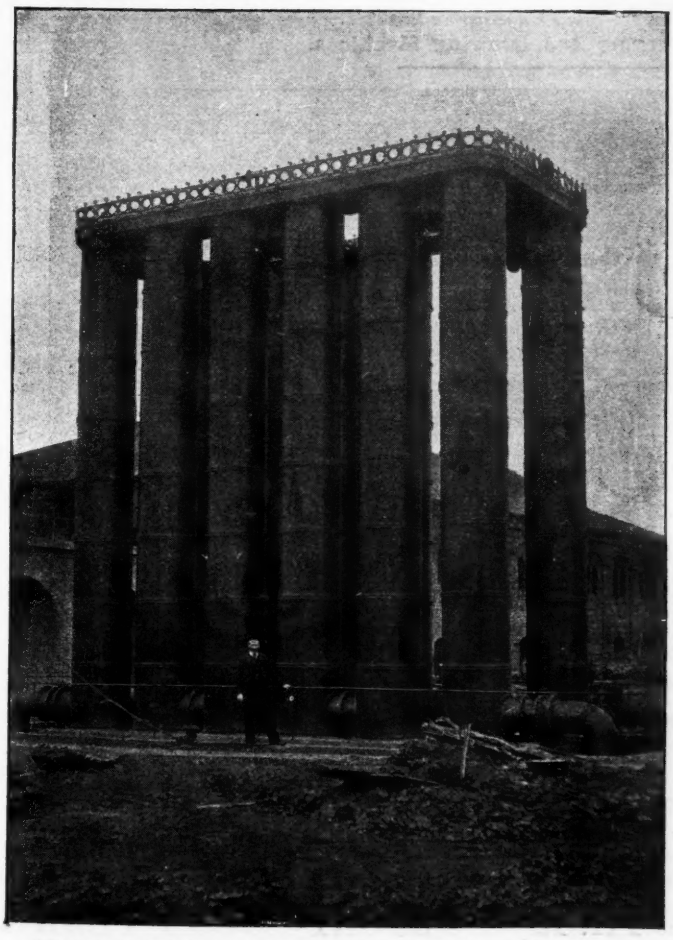

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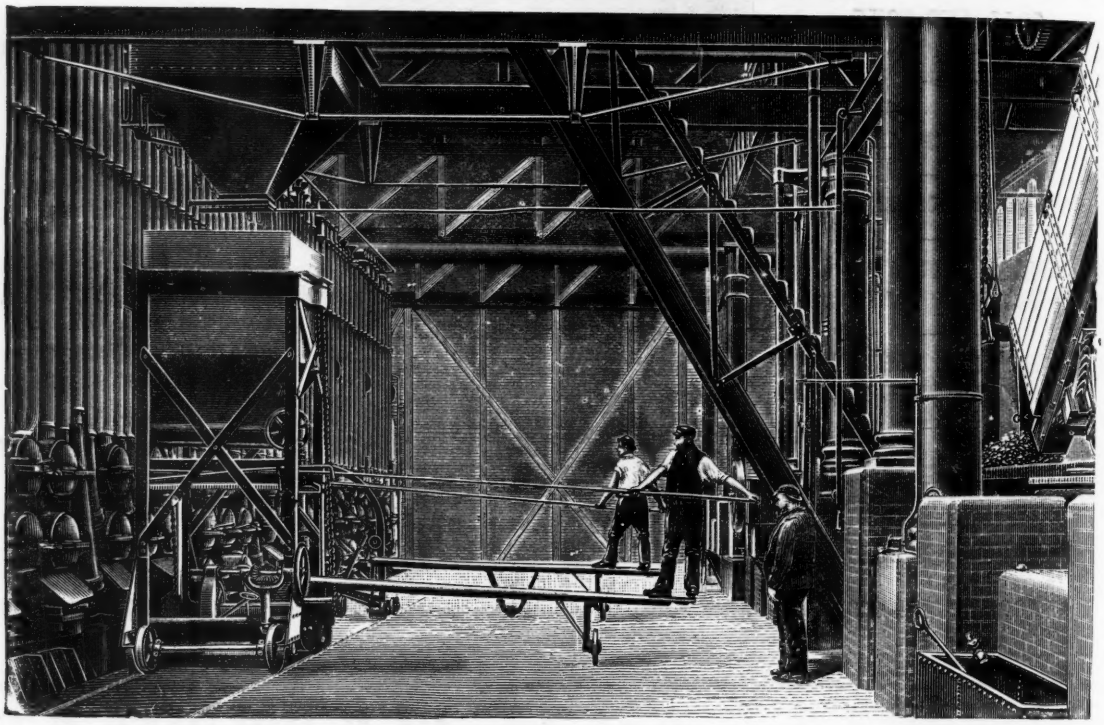

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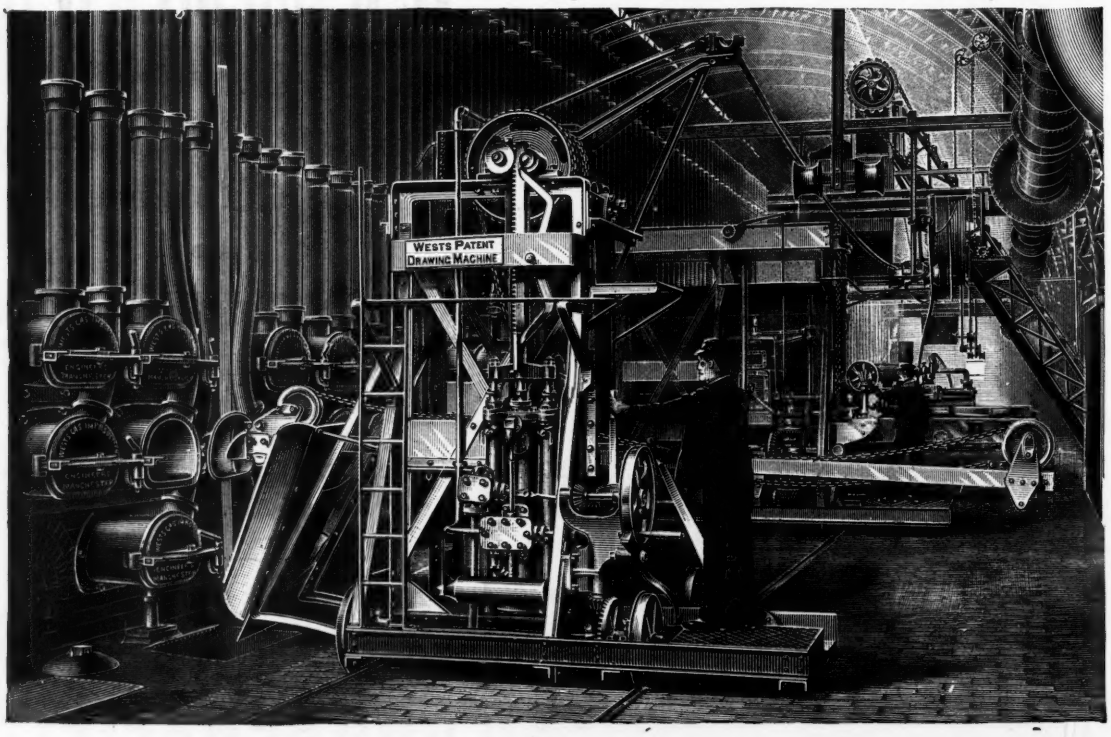

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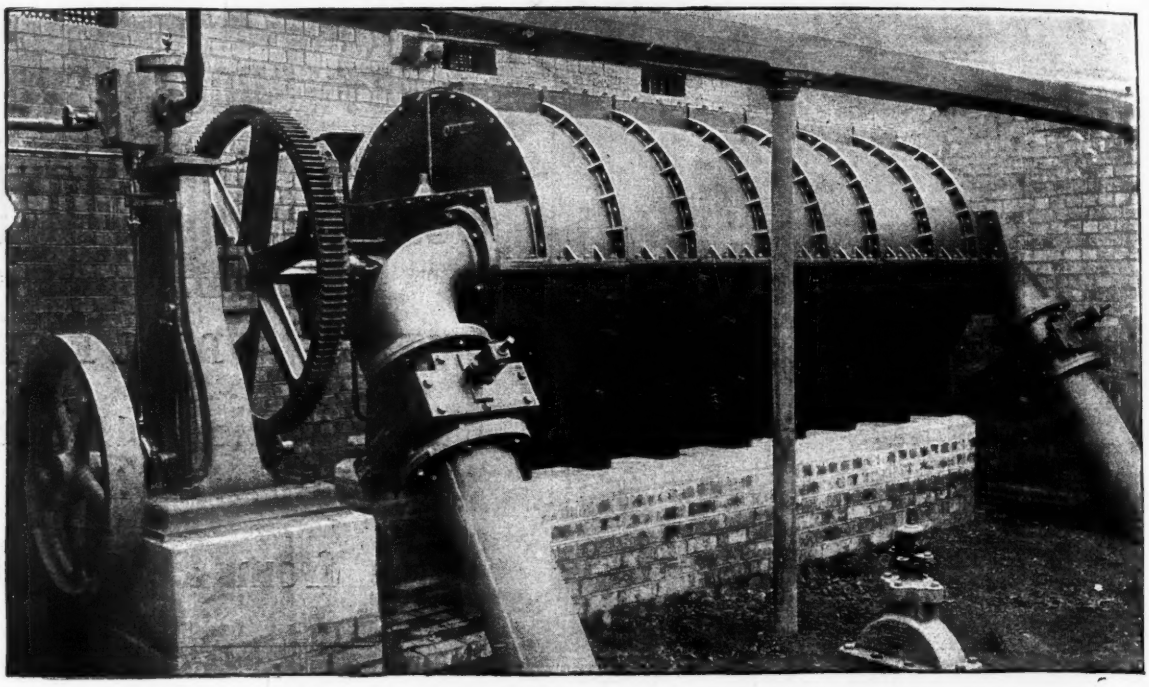

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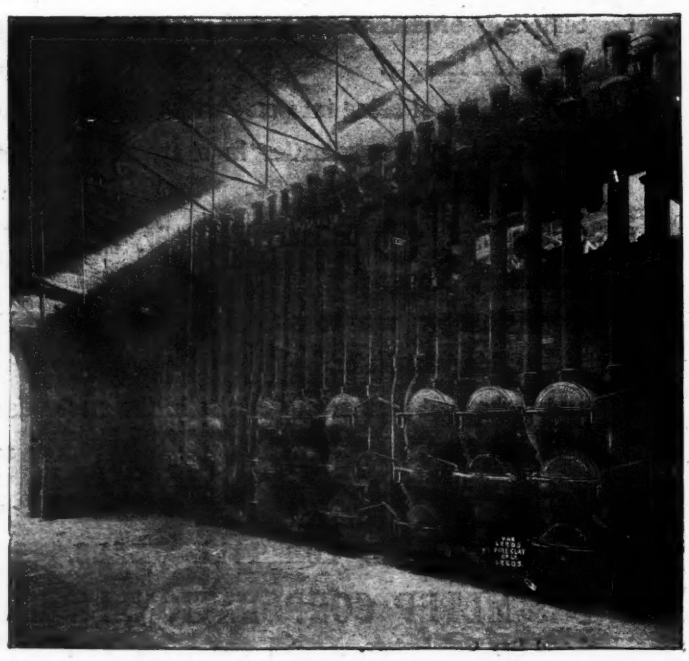

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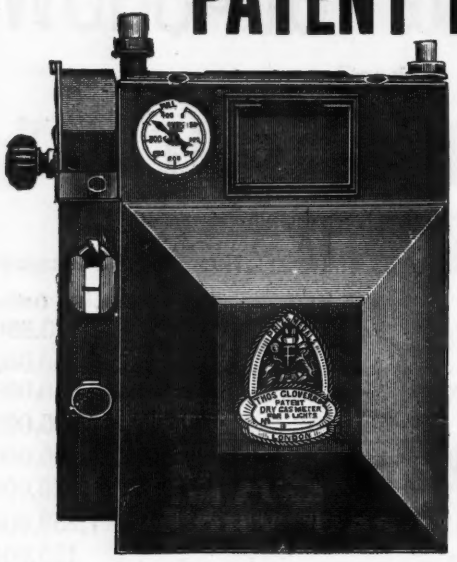

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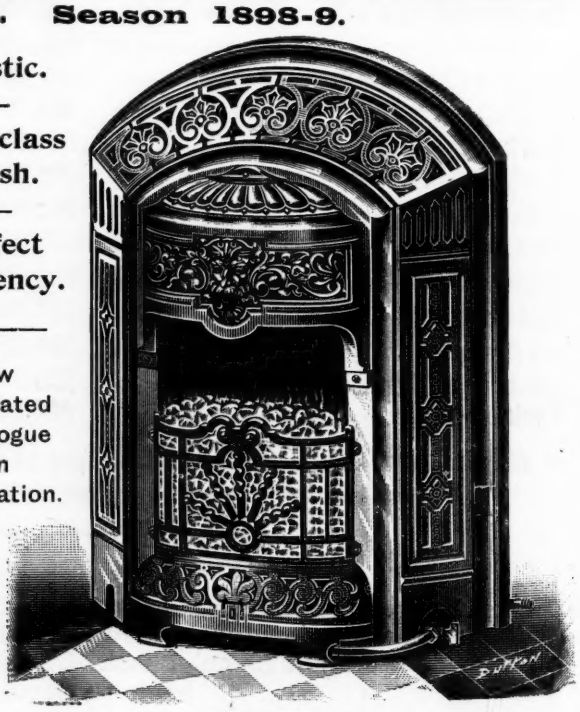

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CONTENTS.

EDITORIAL NOTES:—
GAS, LIGHTING, &c.— PAGE
The Employers' Parliamentary Council 1401
The Sulphate of Ammonia Committee. 1401
The Taxation of Gas in Italy. 1402
The Latest Words on Acetylene. 1402
The Technical Press on London Smoke 1402
Sir Archibald Geikie on Science in Education 1403
Trade Union Deputations 1403
WATER AND SANITARY AFFAIRS—
The Progress of the Metropolitan Water Inquiry 1403
The Meetings of the Southwark and Vauxhall and the Grand Junction Water Companies 1404
ESSAYS, COMMENTARIES, AND REVIEWS:—
Gas and Water Companies in the Stock Market 1405
Electric Lighting Memoranda 1405
The Election of the First Workmen Directors of the South Metropolitan Gas Company 1405
The Discoverer of Coal Gas—A Dutch Claimant to the Title . . 1407
NOTES:—
Tints of Iron Oxide Paints—Main Laying under Water—Gas for Electric Lighting Installations 1407
The Nature and Origin of the Light of Fireflies—A "New Process" of Combustion 1408
TECHNICAL RECORD:—
Acetylene.—Concluding Lecture by Professor V. B. Lewes . . 1408
Society of Chemical Industry 1412
The Theory of the Water-Gas Process. 1412
British Association of Water-Works Engineers 1414
REGISTER OF PATENTS:—
Mantles for Lighting by Incandescence—Plaissetty, A. M. . . 1417
Gas-Exhauster Regulator—Cutler, S. 1417
Anti-Vibratory Supports for Incandescent Burners—Eldridge, J. 1418
Burners for Acetylene or Rich Oil Gas—M'Conechy, J. . . . 1418
Oil-Injector for Water-Gas Carburetters—Botley, C. F., and Cutler, jun., S. 1418
Extinguishing Gas-Lamps at a Predetermined Time—Gunning, J. 1418
Generating and Storing Acetylene—Stott, J. 1418
Pepayment Apparatus for Meters—Mayer, C. P. 1418
Acetylene Generator—Rosenthal, K. E. 1419
Charging Gas-Retorts—Ingram, S. J. 1419
Incandescent Gas Lighting—Boult, A. J. (Salzenberg, E.) . . . 1419
Patent Notices 1419
CORRESPONDENCE:—
The Carburation of Coal Gas 1420
Prepayment Meters 1420
Slot Cookers and all About Them 1420
Automatic Installations and Landlords' Consents 1420
Fire Risks Attending the Use of Gas-Stoves 1420
LEGAL INTELLIGENCE:—
High Court of Justice—
Chancery Division—Incandescent Gas-Light Company *v.* New Incandescent (Sunlight Patents) Gas Lighting Company. . 1421
Queen's Bench Division—The Stamp Duty on Policies of Insurance under the Workmen's Compensation Act 1421
Incandescent Gas-Light Company *v.* Hawes 1422
Disputed Water-Rates at Eastbourne 1422
Rent Collectors and Water-Rates 1422
Disputed Meter Registration. 1422
MISCELLANEOUS:—
Meeting of the Continental Union Gas Company, Limited . . 1422
Meeting of the Southwark and Vauxhall Water Company . . . 1424
Meeting of the Grand Junction Water-Works Company. . . . 1425
Falmouth Corporation and the Gas and Water Companies. . . 1426
Electric Lighting Notes 1426
Sales of Stocks and Shares 1427
Stockton and Middlesbrough Water Board Bill 1427
Metropolitan Water Commission—Fortieth and Forty-First Days 1428
The Derwent Water Scheme. 1430
The Purchase of Private Water-Works in New York 1430
Notes from Scotland 1431
Current Sales of Gas Products 1432
Coal Trade Reports 1432
Gas and Water Companies' Stock and Share List 1432
PARAGRAPHS:—
OBITUARY; Mr. J. H. Fellows, J.P.; Mr. John Hall, J.P. . . . 1407
Reduction in Price by the South Metropolitan Gas Company—The "Robert Hunter Fund." 1404
Society of Engineers 1407
Mr. Walter Hunter on the London Water Supply 1412
The Assessment of the Prescot Gas Company's Undertaking . . 1420
The London County Council's Water Bills 1422
Rating of Reservoirs and Mains—Brigg Gas-Works Purchase . . 1426
The Public Lighting of Grays—Hull Corporation Gas Supply. . 1427
The New Water Scheme for Ledbury 1430
The Lighting of Carlton Colville—Explosion of Gas at Tunbridge Wells—The Gainsborough Gas-Works Purchase Question . . 1431
The Assessment of the Bury St. Edmunds Gas-Works 1432
Public Incandescent Gas Lighting—Acetylene Gas Lighting on the Continent—New Joint-Stock Companies—Frontagers and Street Lighting at Ipswich—Gas and Water Charges in Large Towns—Assault on a Welsbach Company's Representative—Gainsborough Water Works—Water Powers of Parish Councils 1433
Truro Water-Works—Stockport Water-Works—Automatic Coal-Gas-Retort Company—Improvement of the Minehead Gas Company's Works—Ashburton Gas-Works—Collapse of a Gasholder Tank in New York—Price of Gas in Berlin—Carmarthen Town Council and the London Water Scheme—Arbitration as to Land for Water-Works Purposes at Brighton 1434
The Purchase of Land for the Washburn Valley Water-Works of the Leeds Corporation—The Harrogate Water-Works Transfer—Munich Gas-Works—The New Water Scheme for Carlisle—The Maidstone Town Council and the Water Supply—Voting of Gas Shareholders on the Gas-Works Purchase Question at Rushden—New Water-Works Loan for Southampton 1435

TO CORRESPONDENTS.

Owing to the Christmas Holidays, the next number of the JOURNAL will be published on SATURDAY, the 24th inst. Correspondents are therefore requested to forward communications so as to reach the office not later than FRIDAY MORNING.

EDITORIAL NOTES.

The Employers' Parliamentary Council.

THE first ordinary meeting of the newly formed Employers' Parliamentary Committee, which is a direct outcome of the Employers' Federation, was held at the Westminster Palace Hotel last Friday, under the presidency of the Earl of Wemyss. This movement on the part of the associated employers of the United Kingdom first took form early in November, when a private gathering of representatives of various Employers' Associations was convened at the same place by Lord Wemyss. This preliminary meeting was largely attended, according to an authoritative statement sent to us shortly afterwards; and the company was wholly composed of accredited and representative employers in all the principal industries and trades of the United Kingdom. These occupations made a formidable list, far too long to give here. The holding of the meeting was suggested by Sir Benjamin C. Browne; and other moving spirits were: Mr. W. Shepherd, Chairman of the London Central Association of Master Builders; Mr. G. A. Laws, of the Shipping Federation; Sir William Lewis; Mr. A. Siemens; and Mr. George Livesey. It was agreed that a Parliamentary Committee representing the employers of the United Kingdom is necessary to keep watch over the interests of both employers and employed, which are continually being threatened and interfered with by Parliament at the instigation of those who profess the cause of Labour, and by their pertinacity and clamour often succeed in bending public opinion to their desires. There has hitherto been no organization directed to ensuring that Parliament shall be put in possession, from an authoritative source, of views of labour and trade questions other than those of professional Trade Unionists, which have prevailed so greatly with the Board of Trade.

The new body formed to supply this want made its first public appearance on Friday, and it seems to have launched itself into political life with every prospect of a successful and beneficial career. In order to avoid misconceptions, the name of the organization has been altered from Parliamentary Committee to Parliamentary Council. It is to be hoped the members of the Executive will keep their eye upon their Chairman. It will never do for the Council to become a mere echo of the Liberty and Property Defence League, some of whose parliamentary performances have been more grotesque than impressive. Liberty is a very fine thing; and Property is eminently desirable in this world. The Earl of Wemyss, however, in undertaking the defence of Liberty and Property against parliamentary aggression, has not always adjusted his protests to the necessities of the times, which in many ways require the interest of the individual to yield to that of the community to which he belongs. The Employers' Parliamentary Council will have plenty to do without tilting against windmills. They will not commit the banalities nor descend to the futilities of the Parliamentary Committee of the Trade Union Congress; but although they will not need incessant advertisement to keep up their strength, they will have to guard against the lethargy that is apt to overcome an army which only acts on the defensive. A policeman is naturally a less interesting figure than the picturesque free-lance of Labour, who goes prancing up and down on his ancient socialistic hobby, decked out in the gew-gaws of brand-new Trade Unionism, calling on the possessors of wealth and influence to "stand and deliver." The policeman must be on hand, however, if only to prevent this blatant vagabond from hurting himself against the immutable bulwarks of economic truth, which he is too short-sighted to see.

The Sulphate of Ammonia Committee.

THE experience gained by this Committee in their first year of active work has enabled them to make and prosecute their plans in good time for the coming agricultural season. That their labours have already borne good fruit, cannot be denied; and what they have done, and are now doing, in the propagation of information for the creation of a greater interest in sulphate of ammonia among the agricultural community will, it is believed, have an even more important effect in the year now very soon to begin. It is rather to be regretted that the "prize essay" in the competition recently closed is not likely to be ready for publication in time to be of service in the early part of the year; but this is not the fault of the Committee. The competitors reached a

number greatly exceeding expectation (altogether above seventy essays were submitted); and consequently the work of adjudication will take some time to perform. The value of the prize at stake, as well as fairness to the competitors, demands that each and all the compositions sent in shall receive careful and critical examination; and the eminence and suitability of the gentlemen who have undertaken the duty ensure that this will be done. It cannot, however, be expected that they can lay aside their ordinary work to attack and get out of hand at once such a ponderous task; so that a little time must necessarily elapse before their award can be known.

In one particular in this organization we should like to see a substantial development. At present the subscribers to the Committee number 138—representing, we believe, about one-half the tonnage of sulphate of ammonia produced in the country. But the number mentioned is only equivalent to one-third of the makers. Of this one-third, we could not name more than a score; and we have not sufficient interest in the matter to inquire who the others are. Therefore we have no knowledge as to who are the non-subscribing two-thirds. But, whoever they may be, we would, with all earnestness, remind them that they are, according to their degree as producers, reaping the benefit, whatever it may be, that has issued from the work of the Committee. Nitrate of soda is backed up by an influential as well as rich Committee; and the greater the number of subscribers to the Sulphate of Ammonia Committee, the stronger will they be, and the more vigorously will they be enabled to carry on their work. A further increase in the price of sulphate of ammonia would be heartily welcomed; but even the maintenance of the present price is surely worth striving for at the modest outlay of 6d. per ton. Let the non-subscribers consider whether it is not so. We understand that arrangements have been made for the merging of the old Association of Sulphate of Ammonia Manufacturers into the new organization; and from the end of the present year the former will cease to exist.

The Taxation of Gas in Italy.

THE condition of the kingdom of Italy has for some time past offered a profoundly disquieting study to economists; and the references to this subject in the speech of the Chairman of the Continental Union Gas Company, reported elsewhere, are not of a reassuring character. Apart from this, there was not much of general interest in the topics of Mr. Arthur Lucas's able speech on the report and accounts. The Company light Milan, which is one of the busiest cities of united Italy; and the curses of the concession system have come home to roost in this case. The essence of this system of gas supply is mortgaging the present to the future; and when the day of reckoning comes, the process of readjustment is usually the reverse of pleasant. In the case of Milan, the realization of the hard-and-fast terms of the prolongation of the concession was attended by many unforeseen complications, including an extraordinarily mild winter, rioting, and a period of dear coal. It never rains but it pours. The Company had to give up £29,000 of revenue from gas, and pay the extra cost of all these complications besides. Over and above all, there are the crushing national and municipal taxes. Nobody who has not lived and attempted to do business in Italy can have the faintest idea of what it means to be "taxed up to the eyes." The ruling idea of the Royal and Communal Governments, when they see a bit of business doing, is to tax it. They tax the raw material, they tax the product, they tax the profit supposed to be made out of it by those interested, they tax the money that passes from hand to hand. In the case of gas supply, as at Milan, the Government take a duty of 2 centesimi per cubic metre; and the Municipality do likewise. This tax of 4 centesimi per cubic metre means 11d. per 1000 cubic feet. Now, being at their wits' end for money, the preposterous National Government have hit upon the happy idea of increasing their 2 cents. to 5 cents. per cubic metre—equivalent to a duty of 1s. 1½d. per 1000 cubic feet. Of course, the Gas Companies are politely informed that it will only be for them to collect the extra taxation from the consumers. Seeing how terribly bled the Italian citizen is already, for the support of one of the least efficient of the civilized Governments of Europe, there can be no wonder at the opposition of the Gas Companies to this additional impost. Italy is in a wretched state; and if the Continental Union Gas Company had to depend entirely upon their business in this country, their prospects would not be bright. They have other large stations, however, which help to redress the balance of their fortunes. The experience of the Company in regard to Italian taxation is enough to reconcile the British gas manufacturer to his old enemy, the hypothetical tenant. The one bright spot in the record of the year's work at Milan is the efficiency and devotion to duty of the Chief Engineer of the station, and other members of the staff, who managed to keep the city from the horror of darkness even with revolution and anarchy raging round the gates of the works.

The Latest Words on Acetylene.

THE course of lectures on "Acetylene," by Professor V. B. Lewes, the last of which we give to-day, constitute a masterly presentment of all that is best worth knowing at the present time concerning this most interesting lighting agent. Speaking generally, the ordinary man whose attention has been attracted to acetylene lighting wants reliable information upon three points, and no more. He requires to know how the acetylene can be produced safely and conveniently for his particular purpose; how it can best be burnt; and how it compares for cost with possible substitutes. It is precisely upon these leading points that Professor Lewes is a most candid, explicit, and trustworthy authority. Those inquirers who desire to know more about carbide of calcium and its possibilities will not go to him in vain; but close practical matters are Professor Lewes's special care. This is abundantly shown throughout the course of lectures. But a good illustration of the method is the lecturer's treatment of the question of illuminating power, in the last discourse. It is by no means easy to compare two different kinds of light-sources on the basis of lighting effect; and the history of commercial electric lighting is a long record of the trick of forcing the technical term "candle power" to subserve purposes never intended by the old photometrists who coined it. Professor Lewes might have juggled with acetylene and coal gas in the same way. But instead he took the straightforward way of comparing the actual average lighting value of a flat flame of acetylene burning at the practicable rate of 1 cubic foot per hour, which is 34 candles, with an incandescent coal-gas burner of the same consumption, which is about half this value. This is a perfectly fair comparison. Again, with regard to the cost of acetylene, Professor Lewes declines to value the gas in the holder, made from calcium carbide at current prices, at less than 40s. per 1000 cubic feet. Even so, there is assuredly a market for it in country-house lighting. The trouble of smoking at the burner is not yet cured; nor does it seem likely to be if, as Professor Lewes avers, the cause is divided between the generator and the burner. We must, however, deny ourselves the gratification of following up the salient points of these fascinating lectures one by one. Professor Lewes himself bespeaks attention for the forthcoming report of the Committee on the exhibits at the recent acetylene show at the Imperial Institute. At the same time, we very heartily endorse his summary of this part of the subject, in which he records his conviction that, "as time goes on, the tendency on the "part of acetylene consumers will be to use the simplest "form of generator available, with a holder proportionate "to the needed consumption." Thanks largely to him, intending users of acetylene for lighting can learn all about it without becoming victims of those tricks of trade which have so quickly gathered round the new industry.

The Technical Press on London Smoke.

SOME of our technical contemporaries have entered into the discussion of the smoke problem as it affects London; and the difference between their reasoned observations and the ravings of the ordinary newspaper writers ought to awaken the latter to the perception that they do not know quite so much about this subject as they do (say) about the peace policy of the Tzar or the inner workings of the mind of Mr. Chamberlain. There has been a meeting at a gentleman's town house, in Onslow Gardens, to consider the expediency of founding a new Smoke Abatement Society. It is a pity that nobody attended to tell the tale of the old one, which came out like a lion and perished like a lamb. Nothing new has transpired concerning the governing factors of the problem. The "Engineer" discusses the subject in its relation to factory working, and agrees with us that, while the burning of bituminous coal under steam-boilers without production of smoke is possible, it is not an economical nor for many purposes a practicable performance.

Our contemporary proceeds to discuss the old story of avoiding smoky domestic fires by the use of anthracite fuel, and concludes that this will never do. Further, it argues that dwelling-house chimneys do not really emit much smoke, because of the trapping of the soot by the chimneys. It is impossible to accept this argument as a statement of truth, in view of what happens to London on a still, cold morning when everybody is lighting up fires. The only handy cure for the smoky London house chimney is the gas-fire; and the more popular these become, the clearer will be the atmosphere.

Sir Archibald Geikie on Science in Education.

One of the most remarkable discourses on the subject of "Science in Education" that we ever remember was pronounced at the opening of Mason University College, Birmingham, for the present session, by Sir Archibald Geikie. The text of this inspiring address was given in the local papers, and also in "Nature" for the 1st inst. It well repays the earnest study of both young and old followers of the truth, as it is, in Science. How true it is that the voice of the Prophet is as greatly needed now as it ever was in the slow development of mankind! Professor Geikie speaks like an echo of the voice of the Age itself. He does not tell the student what is wanted to be known, but simply how to set about knowing anything and everything that is to be known of any subject. He warns students of science and technology against neglecting the older learning and "humanities." Devotion to science is good; but it is by no means everything. The most scientific of men may be a hopeless bore, and as hopelessly incapable of conveying to others what he knows himself. Among the mental habits which good education in science helps to foster, Professor Geikie named some that are bound to tell in any career. These are: Accuracy, Thoroughness, Breadth, Reading, and Patience. Equipped with these qualities, a student is certain to go far; and wherever he may go he will carry, and find, treasures new and old. To read Professor Geikie's address is almost enough to persuade one to hie to Birmingham forthwith, for the purpose of becoming a student of Mason University College. In default of this, the next best thing is to take Professor Geikie's wise and eloquent words to heart, registering the silent vow to live up to them as perfectly as may be in one's limited sphere. Such counsel is a complete university curriculum.

Trade Union Deputations.

Very fittingly, the year's record of the Trade Union movement was completed last week by a couple of Ministerial receptions of a select deputation from the Trade Union Congress. The President of the Board of Trade first received the party, which sought to interest him in the grievances of railway servants and certain complaints of travellers by workmen's trains. It is a familiar charge against employers that any workman who makes himself conspicuous in agitating for the removal of an injustice or the obtaining of a benefit becomes a "marked man," to be got rid of on the first plausible pretext. The allegation is a very serious one; and we wish we could believe that it is always groundless. Unhappily, the evil exists in all grades of society, and is responsible for an incalculable amount of suffering. Nobody knows the extent to which the effects of envy, hatred, malice, and downright tyranny are allowed to range, through the reluctance of the victims to complain for fear of being "marked." Railway servants are far from being the only, or the greatest of sufferers from this kind of injury, which is as old as humanity, and as common as human meanness and spite. "Belling the cat" has never been an easy and painless operation, and never will be. Mr. Ritchie rightly promised the deputation that a full investigation should be instituted into all cases of individual persecution brought before him; and this is all that can be done. There are, of course, two sides to every question of the kind that may occur in reference to the disciplinary course of works management. The workman who is by habit and temperament a busybody, although his interference may sometimes have a reasonable cause, is sure to get himself cordially disliked in the end, and will be "shunted" at the first opportunity. Employers do not like "sea lawyers." One such talkative, bumptious individual will be a centre of discontent for a whole factory; and the sooner he is put outside, the better for everybody.

After speaking very frankly and sympathetically on the subjects brought under his notice, Mr. Ritchie turned the tables upon the deputation and "went for" them, as representative Trade Unionists, in regard to the falling-off of British exports. He declared that a main cause of the comparative decline of the export trade of the country was "the unhappy disputes which had from time to time "occurred between capital and labour." He cited the engineers' strike and the South Wales coal war, which had caused immense loss to the trade of the country, and inquired who had gained by them. Not the workmen, and certainly not the employers. It would not have been difficult for the President of the Board of Trade to fix the responsibility for these outbreaks. But, like a prudent statesman, he was content to let history speak for itself; only asking that there may be no repetition of such senseless rebellions. Later in the day, the same deputation saw the Chancellor of the Exchequer, with the object of asking the Treasury to assist in the removal of the obstacle to the unlimited deposition of Trade Union funds in the Post Office Savings Bank. They asked that the Trade Unions should be treated the same as Friendly Societies in this regard. In reply, they were told that Trade Unions are not very "friendly" societies, in any sense of the word. The Chancellor of the Exchequer objected to becoming the custodian of Trade Union war-chests, for various reasons, and reminded the deputation of the fact that their societies do not discriminate between strike and benefit funds. The impeachment was not denied; but Mr. S. Woods remarked that there was a custom, after a strike was over, of repaying the amount borrowed for fighting purposes from the benefit fund. The Chancellor of the Exchequer "was afraid there "had been cases where that had not been done." He told the deputation finally that, if they would allocate their society funds to different applications, he would try to meet their wishes in regard to the strictly provident and benefit accumulations. Altogether, these deputations seem to have gone to Ministers for wool, and to have come away pretty closely shorn.

WATER AND SANITARY AFFAIRS.

The Royal Commission on the London Water Supply held yesterday their forty-second meeting for the reception of evidence. The Royal Commission of which Lord Balfour of Burleigh was Chairman sat on forty-five days, during which the reception of oral evidence occupied thirty-two. That Commission obtained some further information by employing Mr. Reginald E. Middleton as an Assistant-Commissioner, to visit certain localities and ascertain the precise facts bearing on the subject of their inquiry. In the present instance, the terms of reference are much more complicated than in the former case, though locally the question seems to rest within narrower limits. Geographically, Viscount Llandaff's Commission does not extend so far as that which related to Lord Balfour's inquiries; and yet the question of a supply from Wales has been taken largely into consideration, and has formed a substantial part of the evidence lately accepted. The Commission seek to ascertain the quantity, quality, and cost of a supply from Wales, as compared with similar items in the case of one from the watersheds of the Thames and the Lea, especially in relation to the scheme of the Staines reservoirs. The question of quantity was well put by Mr. Walter Hunter in his evidence last Tuesday, when he remarked that, having a river at our feet with an average daily flow of about 1300 million gallons, it was suggested that we should go to Wales and rely on a watershed yielding, at the utmost, 415 million gallons per day. Supposing the Thames to be discarded, as the County Council seemed at one time to intend, within a certain period the Welsh supply would fail; and the County Council would then have to come back to the Thames to get the additional water which would be wanted. If the Thames water was good, and the supply from that source was the least expensive, Mr. Hunter submitted that it was absurd to go to a distant watershed until compelled to do so. In reply to this argument, Major-Gen. Scott remarked that the future of the Thames supply was "admittedly uncertain." We are surprised to hear this, except on the philosophical basis that nothing is sure in this world. General Scott's idea seemed to be that, with an increasing population, the quality of the Thames supply might seriously deteriorate. This would depend on what was allowed to go into the river. The population above

the present intakes on the Thames has largely increased during the last half century; but is there any evidence that the supply taken through these intakes has undergone deterioration? Sir E. Frankland gives data for the last 30 years, which, so far from showing progressive deterioration in the supply, demonstrate marked improvement.

No doubt the quality of the supply as it reaches the consumer depends in a great measure on the efficiency of the filtration effected by the Companies. But filtration will be required for the Welsh water; and Mr. Hunter has remarked that if the Londoners had the brown water of Wales and Thirlmere supplied to them, "there would "be an outcry." Mr. Middleton gave similar evidence; and the October report of Sir William Crookes and Professor Dewar—very incorrectly quoted by the Daily Press, or else incorrectly cited by Mr. Balfour Browne—states that, in their experience, extending over a period of fifteen years, they have seldom, if ever, known the colour of the London Water Supply, in its most peaty condition, to equal the average colour of Loch Katrine, Thirlmere, or the Welsh Lakes. The "pure nectar" referred to by Lord Llandaff thus resolves itself into something like brown sherry. As to the matter of cost, even Sir Benjamin Baker and Mr. Deacon admit it must necessarily be more expensive to bring water from Wales than from Staines. If so, why should London incur the larger cost? Close at hand, London has an ample and a good supply; and whatever may happen a hundred years hence, there is no reason why the present generation should seek any other. With their present powers, and with their existing works, the Companies have a surplus of 24 million gallons a day; and the scheme of intercommunication will provide for turning this in any direction where it may be wanted. On the financial aspects of the question, Sir Frederick Bramwell has given some decided evidence, as well as on the engineering points. Supposing the Water Companies to be bought up, and the supply confided to a municipal authority, the example of other cities shows the likelihood that a rate-in-aid would be resorted to. In such a case, as Sir Frederick pointed out, industrial concerns in the Metropolis supplied with water from their own wells, would be subject to "a new tax." This would be paying for water supplied to somebody else. Sundry extravagant notions, hostile to the Water Companies, have been mooted of late before the Commission; and also, we may say, by some of the Commissioners themselves. It is surely no contention on the part of the Companies that, if there are frosts or droughts, they need not supply any water at all, and may "still go on." The remark emanated from Lord Llandaff, and was followed up by Mr. Balfour Browne, who averred that if the drought were to last a whole year the Companies would not be bound to supply a single drop of water. It was suggested that this consideration would influence the arbitrator in the event of purchase. We venture to say that an arbitrator would have too much good sense to regard it.

Two of the London Water Companies have held half-yearly meetings during the past week; and were it not for the hostile attitude of the County Council, the Metropolitan Water Supply would rest on a satisfactory basis for the whole of the Companies and for the consumers. There is nothing whatever in the position of the Companies inimical to the interests of the public; whereas the aggressive tactics of the County Council, could they be successful, would add to the local burdens of the Metropolis without any corresponding advantage. At the meeting of the Southwark and Vauxhall Company, presided over by Alderman Sir H. E. Knight, the magnitude of this particular undertaking was shown by some striking figures in the speech from the chair; and certainly it could not be said that the Directors, as supported by the shareholders, had stinted their outlay in seeking to maintain a full and satisfactory supply. The capital account now stands at about £3,000,000, and in a few years more will be increased to £4,000,000. One-sixth of the water supply of London is furnished by the Company; and the daily supply per head is several gallons above the average, though the Grand Junction is higher, and to some extent the Chelsea. That the Company are spending money wisely as well as freely, is shown by an increase of £11,000 in their water-rents in one year. Some of the expenditure is indeed of a forced and undesirable character, due to the action of the County Council. No blame attaches to the Government for instituting the present Royal Commission; yet the inquiry has been simply brought about by the agitation set on foot by the Progressives, and the Water Companies are put to a heavy expense in order to appear before the Commission with a due representation of their case. There is a further expenditure to come during the ensuing session in fighting the Water Bills of the County Council. But what the Chairman designated as the "innate prosperity" of the Southwark and Vauxhall Company enabled the Directors to pay a dividend for the half year at the rate of 7½ per cent. in place of 6 per cent. per annum; and Sir Henry was confident this rate of dividend would be maintained in the next half year. Beyond that he would not prophesy until he met the shareholders again. In the discussion which followed the Chairman's speech, an act as just as it was generous was performed, by the unanimous adoption of a resolution moved by Dr. Chesshire, that the remuneration of the Directors should be increased by £1000 per annum. Compared with the other London Companies, the Southwark and Vauxhall Company have hitherto given their Directors a singularly scanty remuneration.

At the meeting of the Grand Junction Company, the Chairman, Mr. F. Tendron, was able to make a statement very similar to that put forth by Sir H. E. Knight. The Company's water-rental showed an increase of £6000, compared with the corresponding half of 1897; and an addition of very nearly 1½ per cent. might be made to the dividend, did they not prefer to sacrifice, as it were, this portion of the present income in order to make payments on account of work that would be beneficial to the Company in the future. The Staines project, when once in operation, would benefit them for nearly forty years to come; but the Chairman contended it was most unjust that they should at the present time have to meet charges out of revenue when the expenditure would only be of advantage to them after the Staines works came into operation. Criticizing the policy of the County Council in pushing forward their Welsh project, Mr. Tendron expressed his belief that, if the Council could get hold of the existing works, they would not be ashamed to throw the Welsh scheme over altogether, and adopt the storage plan in the Thames Valley. The County Council might well do this, and the public be the better for it. Mr. Tendron stated that the Grand Junction Company would be able to provide for the increased population in their district by their share of the Staines reservoirs right up to 1937. The more the case is gone into, the more evident does it become that the Welsh scheme is unnecessary, even if perfect in itself, which it is not; whereas the Companies offer all that is required, or that will be wanted for long years to come, and at a price many millions less than that appertaining to the scheme of the County Council. Lord Onslow repeats his warning concerning the "rate-in-aid," and shows how it may even become something more than 5d. in the pound. Attention was called in "The Times" of yesterday, in a letter from the Special Correspondent of that journal, and another from "Thames," to the little professional and scientific value attaching to the report on the Welsh project which the County Council have obtained from Sir B. Baker and Mr. Deacon. We commented on this singular characteristic at the time the report first appeared.

Reduction in Price by the South Metropolitan Gas Company.—The Directors of the South Metropolitan Gas Company have decided to reduce the price of gas 1d. per 1000 cubic feet (bringing it down to 2s. 2d.) as from Christmas, and to increase the quantity of gas sold by slot meters from 27 to 29 cubic feet for 1d. as soon as the 80,000 meters of this kind now in use in the Company's district can be altered. When the previous change in price was made, no concession could be allowed to the prepayment consumers owing to the large amount of work entailed for so small a reduction; but this is now more than made up—the additional quantity of gas to be given being equal to 2½d. per 1000 cubic feet.

The "Robert Hunter Fund."—There is only one contribution to the fund to acknowledge this week—viz., £1 from Messrs. J. E. Williams and Co., of Manchester—making, with the amount already acknowledged, £267. As the "JOURNAL" fund is to be closed by the end of the year, will intending subscribers who have not so far sent in their contributions kindly do so before the 31st inst.? An opportunity has not yet presented itself of determining, after consultation with Mrs. Hunter, the exact disposition of the fund; but due intimation will be made in the "JOURNAL" early next year as to what has been done with the amount placed at her disposal by those whose names have been given in our pages during recent weeks.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1432.)

THE Stock Exchange had a good time last week. Not that business was superabundant—in fact, it was rather the other way—but there was a cheerfulness all along that made things buoyant. The influence was most apparent where there was most activity; and as the American market had the bulk of the business, so it had the largest advance. Most other departments shared the improvement in various degrees; and the slightly lower price of Consols is quite accountable for in the Money Market. The settlement was not a heavy one; and it presented no difficulties. It produced a smart demand for money; and a still stronger demand may be expected next week, after which the probabilities are in favour of easier conditions. Business in Gas was very quiet. Not much stock was on offer, except that of undertakings affected by special circumstances. Apart from these, the general tendency was steady. In Gaslights, the "A" opened unchanged, and was only lightly touched throughout the week at about middle prices; and it closed at the same. A fair amount was marked in the secured issues; the debenture stocks commanding higher figures. South Metropolitan was still inclined to droop; and, a parcel being "specially" done on Friday at 136, the quotation fell a point. Nothing at all passed in Commercials. In the Suburban and Provincial group, a transaction in the seldom seen Bromley put the price up; but British had a material decline. This, however, is no more than is warranted by the reduced rate of dividend; and at present figures the shares stand at a 4¼ per cent. price for money, which is the fair average for high-class issues. Business was slack among the Continental undertakings; but they stood well. Imperial pushed up a point; and Union was calm and steady under the difficulties it has had to encounter—an agreeable tone being set by the proceedings at the recent general meeting. None of the rest made any move calling for special remark. Transactions in Water were of the usual quiet description. The general tendency was steady; but movements were a little chequered. Chelsea and Southwark advanced in view of higher dividends. But New River relapsed; and East London debenture fell back more in line with figures realized by the recent issue.

The daily operations were: Business was moderate enough on Monday. Most of it was in Gaslights; and the 4 per cent. debenture rose 1, and ditto 6 per cent. 2. New River Water fell 2. Transactions in Gas on Tuesday were extremely light. Bromley old gained 1. In Water, Chelsea advanced 1; but East London 3 per cent. debenture receded 1. Wednesday was just as quiet. British began falling with a drop of ½. On Thursday, there was a slight revival of business. Imperial rose 1; but British fell 2. Activity was not maintained on Friday. Everything was quiet and unchanged. Saturday was as quiet as usual. South Metropolitan fell 1; and British, ½.

ELECTRIC LIGHTING MEMORANDA.

The Electric Lighting of the City of London—Are the Contracts Null and Void?—Repair, not Reprisal—The Prudent Course.

THE question of admitting competitive electricity supplies into the City of London has naturally been forced into greater prominence than ever by recent legal proceedings. The subject came before the meeting of the Corporation last Thursday, when a petition was received from the Charing Cross and Strand Electricity Supply Corporation, stating that the applicants are prepared to supply electrical energy to the whole City, and asking the assent of the Corporation to their undertaking such supply in competition with the City of London Company. The application raises some interesting points of law and practice. First of all, there is the question of systems, upon which the "Engineer" only the other day was so dogmatic. Our esteemed contemporary assured the world at large that "low-tension continuous current distribution has had its best day;" yet here we have the example of one of the most successful electricity supply companies in London basing a vast scheme of extension upon the superior cheapness, steadiness, efficiency, and safety of their low-tension distributing service. All the theorizing in the world will not answer such a case as this. If the high-tension alternating system, as worked by the City of London Company, were all that some electrical engineering fancy paints it, there should be no room for the Charing Cross Company in the same streets. As a matter of fact, the memorial of the would-be competitors was very numerously and influentially signed by genuine City firms, including some 29 bankers, 81 insurance companies, and 82 newspaper proprietors. The presenter of the petition moved that it should be referred to the Streets Committee for consideration and report, which was agreed to.

The initial objection to the reception of the petition was that the Corporation were bound by their contracts with the City of London Company not to depart from the existing arrangement, by which the Company have the monopoly of electric street lighting in the City for a term of 14 years longer. Since the memorial was drawn up, however, certain unexpected things have happened. It was admitted in evidence in the hearing of the libel action discussed in this column last week, that the official Chairman of the City Commissioners of Sewers at the time was pecuniarily interested in the contracts. By the Act which regulates the proceedings of this authority, it is provided that no person being a Commissioner or a member of the Courts of Alderman or Common Council shall be directly or indirectly interested or concerned in any contract for the execution of any works, on pain of forfeiting £100 and the invalidation of the contract. It is not for us, of course, to say whether this very proper and usual enactment actually invalidates the contracts of the City of London Company with the Corporation. Some members of the Court of Common Council think that it does, in which case the legal obstacle to the proposal of the Charing Cross Company disappears. It does not follow, however, that the deliverance of the Corporation from their special engagements with the City of London Company means their assent to the competition of the Charing Cross Company. It may induce the Corporation to undertake the supply themselves. And if certain members have their way, this is how the situation will work out. Not being asked for our advice, we are free to offer the opinion that the Corporation should think several times before undertaking competitive electric lighting, as favoured by Mr. Brooke-Hitching and Mr. W. H. Pannell at the last meeting.

There is a very natural desire on the part of those members of the Corporation who resent the ancient scandal raked up afresh in the Law Courts, to do something to illustrate in the plainest fashion the deliverance of the Corporation from the consequences of Mansion House "indiscretion." Also, the modern tendency in favour of the direct supply of electricity by Local Authorities is sure to sway the Common Council. The argument against falling into the arms of a new Company on the morrow of emancipation from the toils of an old one is certain to tell heavily against the Charing Cross petition. All the same, the wise course is that recommended by Mr. A. C. Morton, who "hoped the Streets Committee would take proper legal and scientific advice, and do their best to protect the interests of the citizens." The real question is not of reprisals, but of repairing a mistake. After all is said concerning Mansion House "indiscretions," the fact remains that the Corporation acted as was thought for the best at the period. So far as the direct interest of the ratepayers of the City is involved, no harm whatever has been done. It should not be overlooked that the terms for public lighting, which is done for 2½d. per unit, are exceptionally good for the City. The new-comers will not promise to do it for less. It may be assumed that neither the Corporation themselves, nor anybody else, could serve the public lamps at such a rate and pay their way, without the help of sufficient private lighting at a more profitable price. The private lighting is the *crux* of the whole affair. The enemies of the City of London Company allege that their private lighting rates are high; but this is a question of degree and comparison.

The much-abused City of London Company would point to the losing business of public lighting as one reason for their high private charge, if high it is. They have to supply the public lighting of the City, actual and prospective, at 2½d. per unit. Their would-be competitors have not at present any public lighting at all. When they enter the City, they will have to perform a proportionate amount of this service; and much good may it do them! Then as to private lighting, the City of London Company's rates are 7d. per unit for the first 6 units consumed in each and every quarter per 8-candle power lamp fixed; for the next 4 units, 6d. per unit; for the next 2 units, 5d. per unit; and 4d. per unit beyond. The Charing Cross Company say they hope to do the work in the City for a maximum charge of from 4d. to 5d. per unit for private lighting, and from 2d. to 3d. for motive power. We should say to the Corporation, Let them do it! There will be precious little profit for anybody in the business, at these prices. Certainly, it will not be worth while for the Corporation to attempt it, and incur all the risk and odium of competing by the aid of public money with private enterprise, for so small and problematical an advantage as any brand-new municipal scheme could show. If the matter is thus regarded from the single point of view of the interest of the citizens, as ratepayers and users of artificial light, there cannot be two opinions as to what had better be done. With the Corporation to see fair, and keep the rival Companies up to the mark in those respects in which the commercial incentive does not operate, the City will do far better than with the Corporation itself going into the business at cut rates.

THE ELECTION OF THE FIRST WORKMEN DIRECTORS OF THE SOUTH METROPOLITAN GAS COMPANY.

WE desire, before the year closes, to place on record a fuller account than has yet appeared of the coming into operation of the measure of constructive statesmanship originated by Mr. George Livesey and embodied in the South Metropolitan Company's Acts of 1896 and 1897. This is what is known to students of industrial politics and gas administration as the "Workman Director" scheme. It is unnecessary to go into the beginnings of this movement, which, with all the development and criticisms,

will be found duly chronicled in the volumes of the "JOURNAL" for the past nine years. Suffice it to state that legislative sanction for the addition of Workmen Directors to the South Metropolitan Board was granted in the Act of 1896, but under conditions which made the concession of principle inoperative. The property qualification of an employee Director was fixed at £250 nominal value of the Company's ordinary consolidated 4 per cent. stock, which he was to have held for twelve months and to continue to hold. Next year an amending Act was passed reducing the qualifying holding to £100 nominal stock. Thereupon proceedings with a view to the realization of the scheme were set on foot.

After a good deal of quiet, informal preparation, carried on both among the old Directors and among the executive and working staff, the Chairman (Mr. George Livesey) circulated under date of Oct. 6 a carefully reasoned appeal to the workmen shareholders to consider the position and responsibilities of the directorate of the Company. He reminded them in this address that the administration of such an undertaking have to deal justly and considerately with all persons doing business with, or having an interest in, the Company. These individuals he classified alphabetically into (1) The gas consumers; (2) the employees of all ranks; (3) the shareholders who provide the capital for carrying on the business; and (4) the tradesmen who supply materials to or purchase products from the Company. If a Director were to take a class view of his duties and responsibilities, so as to favour one interest always, and ignore the others, he would be worse than useless. It might be observed that by the ordinary constitution of joint-stock companies, only one class of interest —that of the shareholders—is directly represented on the board of management. This is quite true; and Mr. Livesey also admits it to be true that Directors are sometimes prone to give too much consideration to the interests of the shareholders, and too little to the other interested parties. "There is a tendency in all men to look first to their own class; but men of the right sort will make the doing of justice all round superior to any personal or class interest, and thus in the long run do the greatest amount of good both for themselves and others."

Let us pause here for the purpose of interposing an observation suggested by these remarks. What is the justification for the democritization of governing bodies, but this principle of uniting all worthy classes of the community in the active work of administration? It is not, in England at any rate, the failure in action of the older forms by which Authority operated, that led to the widening of the national deliberative and executive organizations. The old governing bodies drawn from a single class of the population, whereof the last remaining representatives were the Grand Juries of counties, were as a rule devoted to duty, regardful of the public interest, and frugal in expenditure—in brief, they were good boards of directors, representing as they did those who were esteemed as having a "stake in the country." The necessity of bringing the people into the work of government, however, has been held to over-rule all considerations of the efficiency of any "governing class;" and so the popular element has been entrusted with power, in full hope and confidence that it will educate itself as kings and landlords have had to do in the discharge of public duty. The only secret and guarantee of success in this regard lies in the assurance that the sense of public duty and of what is due from man to man is not confined to one class of Englishmen. Englishmen have always had a genius for self-government such as men of no other race have exhibited; and their instincts are in sympathy with government, provided that it is just and ordered in a way they can understand.

This being once granted, there was ample justification for Mr. Livesey's trust in the good sense, in the selection of the first Workmen Directors of the South Metropolitan Company, of the constituency called to exercise their franchise. He promised, on behalf of the old Board, that the new members would be welcomed "with the full desire and purpose to work on the most friendly terms with them." The staff employees of the Company had decided not to take any part in this first election; thus leaving the field quite clear for the wage-earning majority. It appeared that forty-eight of the workmen possessed the necessary qualifications of holding the required amount of stock and having been not less than seven years in the Company's service. This is in itself a remarkable testimony to the efficacy in promoting thrift of the profit-sharing scheme.

These eligible individuals were unequally distributed over the Company's stations. At Bankside, there was none; at Rotherhithe there were two, of whom only one was willing to stand as a candidate; at East Greenwich, there were six, of whom one stood; at Greenwich, of seven qualified, there was no candidate; at Vauxhall, out of fourteen qualified, one stood; and at the head-quarter station of Old Kent Road, out of nineteen qualified, there were nine candidates. In this case, a preliminary vote was necessary to determine the selection of the one representative candidate for the station. This sifting process was not necessary in the case of the other stations. The effect of the preliminary voting would be to reduce the final list of candidates to four names, one each for East Greenwich, Old Kent Road, Rotherhithe, and Vauxhall. Lastly, on Oct. 28, every voter at all the six stations was invited to vote for two out of the four candidates; and the two who received the highest number of votes were to be entitled to take their seats at the Board on Wednesday, Nov. 2.

The number of votes of every shareholder, and the method of voting, were set out on the voting papers, which were sent by post to the voters about a week before the date of the election. The voting power was one vote for every £10 of stock up to £100; after that, one vote for every £25 of stock up to £300; after that, one vote for every £50 of stock up to £1000; and no more. Consequently, the voting could not be by ballot, but was conducted exactly as in the case of ordinary shareholders' voting. Having explained all this, Mr. Livesey was careful to add that it was not for him or any man to suggest which of the four candidates should be selected. He laid the greatest stress upon the fact that this responsibility rested wholly and solely upon the workmen shareholders themselves, and was non-transferable. The circular concluded thus: "Every voter is perfectly free to vote as he pleases. All that I ask is that he will give his votes to the candidates that he honestly believes will work best for all the interests bound up with the Company. In this, the last step of the top stone of our profit-sharing system, I confidently expect the most suitable men will be elected; and, when it is proved to the world that this confidence has not been misplaced, the workmen shareholders of this Company will have the satisfaction that they have worthily and honourably done their part in an earnest effort to improve the relations of employers and employed in the great British Nation."

From one of the voting papers for the Old Kent Road workmen that lies before us, we learn that of the nine candidates from this station the period of shortest service was eleven years, and of the longest twenty-six years. The occupations of the candidates were as follows: Automatic collector; storekeeper's office; foreman, retort-house; automatic collector; chief foreman, retort-house; fitter; horsekeeper; foreman, retort-house; and service layer. In the first voting, the bulk of the suffrages went to John Alfred Butcher, of the storekeepers' office, and to Henry Fox, chief foreman, retort-house. Ninety-five voters did not vote. As neither of the leading candidates obtained an absolute majority of the votes polled, there was another contest, which resulted in the selection of Mr. Butcher. At the final voting, Mr. Butcher and Mr. Austin, of East Greenwich, became the first Workmen Directors of the Company. Writing at the time, Mr. Livesey expressed the opinion that "unquestionably the best and most suitable men had been selected." It is fair to say, however, that there was little to choose between the last four men left in the running.

Thus was answered one of the cheap and ready-made objections urged against the Workman Director scheme—that the voters would bestow their favours upon unsuitable men. It was shown, moreover, that the workmen shareholders took a most active and intelligent interest in the voting, quite five-sixths of all the voters going to the poll. It is not to be wondered at, therefore, that Mr. Livesey, in communicating the result of the election to the "JOURNAL," remarked: "So far, all I can say is that I am greatly pleased." And well he might be. How the Workmen Directors will be found to answer—not as regards their own persons, for it would be impertinent to question their character or ability—but as part and parcel of a system, is to be shown only by time, which tries all things. What is at least certain is that the South Metropolitan workmen shareholders have justified themselves by their conduct of the election. We have never been able to understand why the workmen of a gas company, who in their capacity of householders are regarded as competent to participate in the government of the British Empire, should be esteemed incapable of picking out from among themselves one or two men to whom they would be willing to entrust the care of their savings, and a voice in the administration of the Company's business.

The two new Workmen Directors of the South Metropolitan Company entered on their office at a most favourable juncture, just after the old Board had conferred a great boon upon the mechanics and yard hands by extending the breakfast interval from the half hour to three-quarters of an hour, and had raised the stokers' wages. Neither of these ameliorations of the gas workers' lot is ascribable to the reformed Board; but they must smooth the way for the new Directors by relieving them of any immediate solicitude for the interest of the class to which they do not cease to belong. These Directors would have been placed in a painful dilemma if the first thing to face them on the *agenda* had been the question of increasing wages or of shortening the hours of labour. If these ameliorations had followed, instead of preceded their elevation, though they might not have claimed any credit for them, it would have been difficult to disabuse the workmen's minds of the idea that the new Directors were to be thanked for the improvement. This would have constituted a claim upon them which would have hampered their future action.

As it is, fortunately, the reformed Board has started with a free hand, under the happiest auspices. It would be almost an insult to Messrs. Butcher and Austin to look for any noticeable effect of their accession to the Board, in the shape of an alteration of the Company's policy or the conduct of their business. Nobody cares, in the ordinary way, who succeeds to the directorship of a gas company, so long as all the requirements are satisfied. The real success of the South Metropolitan Workmen Directors will be of another kind. It will consist in the demonstration of the great truth that Capital and Labour can join hands, not only in carrying on, but also in conducting a vast business. Labour will see in this a very clear object-lesson on

the folly and error of the teaching that Capital must always be preying upon it, keeping it in subjection, and opposing all its aspirations for more ease and still greater profit. The existence of the Workman Director is a proof that there is no plot of Capital against Labour. The experience of these Directors will also avail to demolish the pernicious doctrine that labour, sheer handiwork, is the source of all profits in business. They will learn, if they did not know before, that it is the mind and resources of the Master that make the work of the Man profitable; the lack of these that renders his labour vain. Lastly, the experiment will go to show that there is no need for the creation of a new Socialist universe on the ruins of the old, to make an opening for the workman to dignify his class, without forsaking his calling. In this age, with the joint-stock system ever more and more shutting out the individual employer, the last consideration is of the first importance. By-and-by, the master of a business which is truly and wholly his own—such as the frugal workman of old might hope to secure by no great effort—will have become extinct. The shareholder will be the only employer; and the workman who is a proprietor and also a director will be the sole representative of the industrious apprentice, who used to marry his master's daughter and live happy ever after.

THE DISCOVERER OF COAL GAS.

A Dutch Claimant to the Title.

A REPORT to the effect that coal gas was discovered and applied to certain uses in 1784 by a Professor Minckelers, has already been noticed in the "JOURNAL" (*ante*, p. 423); but evidence in substantiation of the statement recently collected by Heer P. Bolsius for our Dutch contemporary "Het Gas," deserves more prominent notice. We therefore propose to relate the more important incidents in the life of a worthy pioneer in scientific research, in support of whose claim to be the discoverer of coal gas there appears to be substantial documentary evidence.

Jan Pieter Minckelers, according to the records of Maastricht, was baptized at a church in that town on Dec. 2, 1748. His father was an apothecary, and he obtained for the boy education at the hands of the Jesuits, with the intention of preparing him for clerical duties. The youthful Minckelers, however, showed a preference for the study of natural science, which he pursued at Louvaine (Löwen) so successfully that, in his 24th year, he was appointed Professor of Philosophy at the University in that town. The professorship of chemistry was at that time held by Heer van Bouchante. After the invention of the air balloon in 1782 by the brothers Montgolfier, who used warm air as the filling medium, Charles inflated a balloon with hydrogen. The use of this gas at once suggested a search for other light gases, which would replace it for the purpose, and could be prepared more easily. Both Minckelers and von Bouchante endeavoured to discover a suitable gas for the filling of balloons; but Minckelers was first able to announce that he had been successful in his quest. He states in a note on "Inflammable Air obtained from Various Materials," that, on Oct. 1, 1784, he put some powdered coal into a gun-barrel, and obtained by distillation a large yield of inflammable air, which was four times lighter than atmospheric air. A balloon of not quite a cubic foot capacity was filled with this gas, and set free near Louvaine. It descended 25 kilometres from the spot. A larger balloon was afterwards filled with coal gas, and set free near the same place; and on Feb. 23, 1785, a well-authenticated ascent of a coal-gas balloon took place near Antwerp.

In 1785, moreover, Minckelers lighted his lecture-room by means of the inflammable air obtained from coal. Van Hulthem, a pupil of Minckelers, communicated this fact to Professor Morren; and Heer van Even, the Louvaine librarian, has found a record of it in the town archives. This use of coal gas by Minckelers anticipates the reported discoveries of it by Lebon in France, and by Murdoch in England. Philippe Lebon was born in 1767, and is reported to have prepared illuminating gas by the dry distillation of wood in 1791. William Murdoch is regarded in this country as the discoverer of coal gas; and 1792 is the year in which he is supposed to have done so. A comparison of these dates leads Heer Bolsius to the conclusion that coal gas was discovered by Professor Minckelers, and was also first applied to illuminating purposes by him.

Minckelers afterwards went to Brussels, but returned to Louvaine in 1790 to pursue the calling of an apothecary. He subsequently took charge of a natural science laboratory at Maastricht. He died in that town on July 4, 1824. The details of his life given in the above account have been taken from Heer Bolsius's narrative, which has been reprinted from "Het Gas" and published as a monograph,* along with a well-executed facsimile of a portrait of the reputed discoverer of coal gas which exists in the archives of Maastricht.

Society of Engineers.—At the annual meeting of this Society on Monday last week, Mr. John Corry Fell was elected President; the Vice-Presidents being Messrs. H. O'Connor, C. Mason, and Percy Griffith. The Secretary (Mr. G. A. Pryce Cuxson) has resigned; and Mr. Perry F. Nursey succeeds him.

* "Korte Levensschets van Jan Pieter Minckelers, Uitvinder van het ichtgas," door P. Bolsius.

OBITUARY.

The death is announced of Mr. J. H. FELLOWS, J.P., of Yarmouth, in his 71st year. Deceased was Chairman of the Gorleston and Southtown Gas Company—a position he had held for six years—and a Director of the Yarmouth Gas Company.

Mr. JOHN HALL, J.P., head of the firm of Messrs. John Hall and Sons, of Lincoln, died suddenly on the 9th inst., at the advanced age of 82. He was a Director of the Lincoln Gas and Water Companies before the undertakings were acquired by the Corporation.

NOTES.

Tints of Iron Oxide Paints.

According to the "Ironmonger," a question has arisen with respect to the reliability of the different tints of iron oxide paints, which are now sold of a variety of shades ranging from dark brown to red or purple. The difference of colour is attended by a difference of price, though the chemical composition of the various pigments of the class is roughly the same. The comparative dearness of the darker tints of oxide paint is due to the fact of the coloration being produced by heating some material, such as ochre, in a muffle furnace; the depth of purple shade produced being due to the period and strength of the heating. Experiments have been carried out in Germany to ascertain whether there is any practical advantage as regards power to resist corrosion in the more expensive grades of this paint. The results of the investigation may be briefly summed up as follows: A purple oxide does resist the attack of acid vapours in the atmosphere better than a brown one; but, bearing in mind the great difference in price, a red oxide is the most suitable for general adoption. The specific gravity of the pigment rises during the furnacing; and, assuming that the colours are fairly pure, it forms a trustworthy indication of their industrial value. The heavier the oxide, the better it is; and, allowing for cost, a specific gravity of 4·2 is the most desirable. Always supposing that the substance is fine enough to grind well into oil, the degree of fineness does not affect the anti-corrosive power of the paint. It may be remarked that acid-resisting capacity is of special importance in the case of oxide paints, because these are most generally employed to protect iron in gas-works, and on railway roofs and bridges, where the metal is exposed to the most active corrosive influences.

Main Laying Under Water.

Another example of main laying under water is reported, in the case of the water supply of the new United States immigrant station on Ellis Island, in New York harbour. The supply is purchased from the Jersey City Water-Works at the price of $100 per million gallons, and is delivered through a 6-inch pipe 5400 feet long, of which 5100 feet is submerged from 10 to 17 feet at high tide. The pipe is in 12 ft. 5 in. lengths, making 12 feet net, weighing 800 lbs. apiece. The metal is ¾ inch thick, and Ward flexible joints are used throughout. Most of the bottom was muddy; and in this a trench 10 feet wide and 5 feet deep was dug for the pipe, by a bucket dredger which deposited the spoil under water alongside, to be used for back-filling. For laying the pipe, two large barges were braced together, side by side, about 6 feet apart; and in the space between an inclined plane of wood was made reaching from the deck level to the bottom of the trench. This plane was hinged at the top, and was 55 feet long, so that as the tide rose the slope merely became steeper. The operation of jointing and lowering the main was continued from one shore end; the other end always resting on the slope, and fresh lengths being added as the barges were warped ahead. When the weather became rough and the barges rocked so much as to strain the joints, the barges were hauled ahead altogether and the pipe allowed to rest in the trench, from which it was afterwards recovered. Progress was made at the rate of 43 joints per day. The main was filled with water to sink it; and after the job was completed, this water was driven out by compressed air, which also showed the leaks. These were attended to by a diver. The work is regarded as a success; the total measured leakage in 15 hours being only 3½ cubic feet at a pressure of 45 lbs. The specification was for a maximum leakage of 1 cubic foot per minute.

Gas for Electric Lighting Installations.

A noteworthy example of the adaptation of gas power to an isolated electric lighting installation is that of the new Palace Theatre at Plymouth. There are some 1200 incandescent, and six Jandus arc lamps in this installation; the generating plant having to be concentrated on a site 30 feet long by 14 feet wide. Upon the ground floor there are four Campbell gas-engines, of 25 to 30 brake horse power; and the dynamos are on the first floor immediately overhead. The different parts of the plant are of various makes; the general design being by Messrs. Veale and Co. In actual working, the following results appear: The usual electricians' grievance about "the peak of the load" is exhibited in an aggravated form, since the lights are only required for about four hours a day, so that the load-line is all "peak." The gas is ready when required, however, and the consumption averages 7000 cubic feet per night, which generates 220 units of electricity. The Plymouth Gas Company's charge

for gas is 1s. 9d. per 1000 cubic feet, which works out to 12s. 3d. per night, or £3 13s. 6d. per week of six days. The cost of the electricity per week is, therefore, as follows: Gas, 42,000 cubic feet, £3 13s. 6d.; wages of two attendants, £2 8s.; oil, waste, and engine sundries, 12s. 6d.—total, £6 14s. for 1320 units, or 1·22d. per unit. It is pretty safe to say that few electric lighting installations in the country work at a cheaper rate. In making up the total cost, other charges have, of course, to be taken into consideration. There is a battery for the day lighting, which cost £300, and may be renewable in five years; and this adds 0·39d. to the cost of the unit. Still, the whole works cost does not amount to 1¾d. per unit, which is an extremely good showing for the combination. It would probably have been more economical still to do the whole lighting by means of incandescent gas-burners, and thus get rid of the complication attending the conversion. But this is perhaps to come.

The Nature and Origin of the Light of Fireflies.

At a time when chemical science is prone to plume itself upon its power to disclose the secret composition of the smallest particles of matter, and physical science professes to be able to explain the phenomena of light upon mechanical principles, it is a little disconcerting to find that the mystery of the cheapest and oldest terrestrial light in the world—the self-luminosity of fireflies—remains impenetrable. Whatever may prove to be the nature and method of production of the "light of the future," which is so often talked about, there are great mysteries still as regards this most ancient of light sources. Many observers have studied the light of fireflies of different species, and of glowworms; and all they have learnt about its production is that it can be extinguished by carbonic acid, and intensified by oxygen. Hence it has been deduced that the light is a combustion effect. As regards the nature of the fuel, and how it burns, recent research has ascertained that the photogenic apparatus is composed of cells of some fatty kind of substance, among which air-passages and nerve fibres are distributed. The active agent—it would be unscientific to call it "principle"—is presumed to be "some form of free phosphorus." This is as pure a guess as might have been framed from the first production of phosphorus itself. The probability of the slow combustion theory of the cause of the luminosity is rudely shaken, however, by spectroscopic examination of the light itself, which goes to show that the light is very rich in ultra-violet rays. If it is due to combustion, therefore, this combustion must be of a nature very different from that which is ordinarily called by the same name. Instead of slow burning producing the same sort of light, it would need the fiercest kind of ordinary combustion to yield anything resembling it. Yet the light of insects is cold. From all this, it would appear a natural inference that science had better begin here at the beginning of terrestrial lighting, before presuming to formulate suggestions about the "light of the future."

A "New Process" of Combustion.

A fine example of the operation known as creating a scientific mountain out of a molehill of practical performance, is afforded in the notices that have lately "gone the round of the Press" respecting a so-styled "new process of combustion" brought before the Franklin Institute by Mr. Paul J. Schlicht. The title is portentous; and Mr. Schlicht has produced a ponderous paper in support of it. Underneath the heap of verbiage, there is an idea capable of being expressed in a sentence. Mr. Schlicht's invention consists in surrounding the flue-pipe of a heating stove for a short distance with a jacket-pipe, through which the air supply for the furnace is drawn. He claims to have "discovered" the fact that "if a current of air is properly introduced into a chimney or flue through which hot products of combustion are escaping, the air-current will flow in a direction contrary thereto, and, becoming heated in its contact therewith, will reach the sphere of combustion in a condition highly favourable to the union of its oxygen with all the combustible elements of the fuel." The suggestion is a curious one. It really means feeding a closed furnace with air by means of its own smoke-flue, which Mr. Schlicht claims to do by a simple expedient. He shows a typical example of a common domestic heating stove, with its flue-pipe projecting through the wall, and then carried vertically upwards in the usual way. The top piece of the flue is a slightly smaller pipe, which is fixed concentrically with the other, so as to leave an annular opening between the two. The lower pipe forms a short sleeve for the upper, open at the top to the atmosphere. This is the source of the air supply, which enters the annular opening and travels down the smoke-flue to the fire; while the smoke is at the same time travelling in the opposite direction, in contact with it. In the case of a horizontal flue, the air can be admitted by an elbow-pipe projecting through the lower side of the flue, and pointing inside for a short length in the direction of the fire—of course, close to the bottom of the flue-pipe. Mr. Schlicht claims manifold and great advantages from his system. The phenomenon of fresh air and the products of combustion travelling in contrary directions in mutual contact, without mingling, was exhibited years ago by one of Mr. Frederick Siemens's recuperative gas-lamps.

The Harrogate Town Council (being now the owners of the water-works) have raised the salary of Mr. W. E. Dixon, their Water Engineer, from £300 to £400 per annum.

TECHNICAL RECORD.

ACETYLENE.

By Vivian B. Lewes, F.I.C., F.C.S.,

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[The Last of a Course of Cantor Lectures at the Society of Arts, delivered Dec. 12, 1898.]

As I have before stated, it was in the autumn of 1894 that I first received a supply of American carbide; and in reporting on this material on Nov. 26 of that year, I wrote: "This gas, when mixed with an equal quantity of air, can be burnt at a No. 4 Bray burner; and the illuminating power of the mixture would be equal to 65·7 candles per 5 cubic feet of gas consumed, which would give the acetylene an illuminating value of 131·4 candles per 5 cubic feet. The presence of an inert gas, such as the nitrogen, in the air is well known to exercise such a cooling power on the flame as to seriously reduce its illuminating value; and I find that if the acetylene be burnt by itself at a suitable burner, it develops no less than 230-candle power per 5 cubic feet of gas consumed." Further experiments made during December, 1894, with carefully purified gas yielded a slightly higher result; and in the paper read before the Society in January, 1895, I gave the illuminating power of the gas, when burnt under the best conditions, as being 240 candles.

A considerable amount of vagueness exists as to what is meant by the illuminating value of a gas; and the only assumption which can be arrived at is that it is the highest illuminating effect which can be produced from the gas without the aid of regeneration or artificial air supply other than that created by the flame itself.

The proper combustion of any hydrocarbon gas, however rich, can be effected by supplying the flame with exactly the amount of air necessary to prevent smoking; and it is under these conditions that the highest illuminating effect possible with the particular burner is obtained.

With flat flames, the ratio between the air supplied and the gas consumed is governed by two factors: (*a*) The thickness of the flame; and (*b*) the pressure under which the gas issues from the burner. When a gas issues from a burner under pressure, the uprush of the escaping gas mechanically draws in air, so that when consuming a poor coal gas in a flat flame the pressure has to be kept down, or too much air would be dragged in, which would consume the hydrocarbons too rapidly and so seriously affect the amount of light emitted; while as the gas increases in illuminating value, more and more air is required for proper combustion, and this can be obtained by increasing the pressure at the burner.

Experience has shown that with ordinary sized flat-flame burners, 7-10ths of an inch pressure gives practically the best results with coal gas of the quality supplied in London; and up to a certain limit, the same flat-flame burner can be used for richer gases by increasing the pressure. When this limit is reached, a thinner sheet of flame has to be employed—*i.e.*, a smaller burner used—low initial pressure resorted to, and then by increasing pressure this can be made to consume gases of increasing value, until the pressure reaches a point at which the flame becomes distorted, when a still smaller burner has to be taken. By such means as these, even acetylene with its enormously high illuminating value can be satisfactorily consumed; while by thickening the flame and reducing the pressure to the point at which the uprush almost ceases to cause a mingling of air with the flame, and leaves the supplying of the oxygen to diffusion, even a poor gas can be made to develop its illuminating power.

On consuming acetylene from a No. 000 union jet burner at all ordinary pressures, a smoky flame is obtained; but on increasing the pressure to 4 inches a magnificent flame results, free from smoke, and developing an illuminating value of 240 candles per 5 cubic feet of gas consumed. Slightly higher values have been obtained; but 240 candles may be taken as the average value under these conditions. This figure is the one quoted by most manufacturers of acetylene apparatus, who argue from it that acetylene is fifteen times as valuable in illuminating power, volume for volume, as London coal gas.

Such a comparison is, however, absolutely misleading, as, in contrasting the value of acetylene with coal gas, one must always bear in mind that the illuminating power of London gas is determined by consuming it at the rate of 5 cubic feet per hour in the London argand; while in practice any power from 8 to 90 candles can be obtained from this volume, according to the form of burner in which it is consumed. Although small flat-flame burners only emit from 1 to 2 candles per cubic foot of gas consumed, good incandescent mantles will yield about 18 candles per cubic foot, and certainly 17 on the average. As incandescent gas lighting is rapidly displacing other methods of burning gas, and as this tendency will be enormously increased when the lapsing of the Welsbach monopoly reduces the price of the mantles to the figure now charged in Germany, it is evident that no calculation is fair that does not include this as a factor.

Moreover, a very short experience soon shows that burners consuming 1 cubic foot of acetylene per hour are the largest that

can be practically used for domestic purposes; and that, taking such burners all round, 32 candles per cubic foot is a fair average of the light developed by them—although out of a big batch of burners one occasionally finds a few which will go as high as 36 or even 40 candles per cubic foot. The influence which the size of the burner and the rate of consumption has upon the illuminating power of coal gas is well known, and is shown in the following table :—

Flat Flame Burner.	Candles per Cubic Foot.	Flat Flame Burner.	Candles per Cubic Foot.
No. 7	2·44	No. 3	1·63
6	2 15	2	1·22
5	1·87	1	0 85
4	1·74	0	0·59

As the consumption of acetylene is regulated by exactly the same factors as act in the case of coal gas, it is evident that the smaller the burner and consumption the lower will be the candle power per foot of the acetylene; and in practice with a ½ cubic foot burner 24 candles per cubic foot is a good result. Taking a series of burners of the Naphey type, obtained from Falk, Stadelmann, and Co., the following results were obtained :—

Burner. No.	Pressure. Inches.	Gas Consumed. Cubic Feet.	Light. Candles.	Candles per Foot.
0	2·0	0·15	0·7938	5·3
8	,,	0·275	3·2	11·6
15	,,	0·40	8·0	20·0
25	,,	0 65	17·0	26·6
30	,,	0·70	23 0	32·85
40	,,	1·00	34·0	34·0

From these considerations, it is evident that the only fair way to contrast the light obtainable from coal gas and from acetylene is to take the incandescent burner on the one hand, and the 1 cubic foot flat-flame burner on the other, when it is seen that, instead of being fifteen times the value of the coal gas as an illuminant, it is only about twice its power. The acetylene burner, however, has an advantage over the mantle—one can more or less regulate the light to the amount required.

When acetylene is burnt in air under such conditions as to complete its combustion, it is converted into carbon dioxide and water vapour—the same compounds as are produced by all combustible hydrocarbons—

$$2\,C_2H_2 + 5\,O_2 = 4\,CO_2 + 2\,H_2O$$

and 1 cubic foot of acetylene requires 2½ cubic feet of oxygen.

The researches of Dr. Gréhant have shown us that, when burning with a smokeless flame, no carbon monoxide can be detected in the products emitted by its combustion; and its sanitary position will, therefore, be defined by the amount of oxygen abstracted from the air and carbon dioxide produced, as compared with other illuminants.

Taking the average sized room which would be well lighted by an illumination equal to 64 standard candles, we find that this amount of light from various illuminants would yield the following results :—

Illuminant.	Oxygen Removed from the Air. Cubic Feet.	Products of Combustion. Water Vapour. Cubic Feet.	Carbon Dioxide. Cubic Feet.
Sperm candles	38·5	26·2	43·6
Paraffin oil	24·9	14·0	39·8
London gas—			
Batswing	26·1	29·4	19·2
Argand	23·0	25·6	17·0
Regenerative	10·6	8·3	5·2
Incandescent	3·1	4·6	1·8
Acetylene	5·0	2·0	4·0

So that, light for light, acetylene fouls the air less than any of our ordinary illuminants, with the exception of the incandescent gas-burner.

In comparing the heating effect of various illuminants on the air of a room, it is necessary to determine the calorific value of the combustion of a cubic foot of the illuminating gas employed; and it is manifest, from theoretical considerations, that a highly endothermic compound like acetylene must have a far higher heating power than ordinary coal gas. The mean of a number of experiments made in Junkers' calorimeter gave as the thermal value of the ordinary London gas supply 158 calories; while under the same conditions acetylene yielded 320.

The theoretical amount of heat emitted by the combustion of a cubic foot of acetylene is 349·08 calories. But this would only be given by the absolutely pure and dried gas; and the experimental number determined in the calorimeter represents more truly the heating power of the moist gas under ordinary existing conditions.

Taking, now, the case in which a room is lit up with a power equal to 64 candles, we find that if we call the heating effect produced by an incandescent mantle giving this amount of illumination 100, then—

Ratio of Heat Emitted to Yield a Light of 64 Candles.

Incandescent mantle	100
Acetylene	115
"London" argands	571
Flat-flame burners	914

So that, for all practical purposes, the heating effect on the air by acetylene is the same as with incandescent mantles.

When we come to compare the cost of acetylene and coal gas, one is again struck with admiration at the statements made by the advocates of the former as a rival to the well-established coal gas industry. At the present time the wholesale price of carbide is £20 a ton; but I believe that to fill large cash orders it can be obtained at £16 a ton at Foyers, which would mean at least £20 a ton at the works where it is to be decomposed and the gas distributed. The decomposition of carbide is not a costly operation; but at least 10 per cent. would have to be added to the price of the carbide for handling, water, repairs, interest on plant, purification, &c., and this would bring the price of the acetylene to £2 per 1000 cubic feet in the holder. Coal gas in the holder, when made on the scale common in our big cities, costs, however, about 1s. 2d. per 1000 cubic feet; and about 100 per cent. has to be added to this to cover charges for distribution and profit. The power of doing this is dependent on the amount of gas sold; and while the South Metropolitan Company can make a fair profit on gas at 2s. 3d. per 1000 cubic feet, there are many small country works that cannot pay a dividend with gas at three times that price. With acetylene, the smallness of the output would necessitate a heavy charge over cost price; and I should be surprised to find an installation of acetylene, even in a fair sized town, paying its way with a less charge than £3 per 1000 cubic feet.

Looked at from this point of view, it is at once manifest how absurd it is to talk of acetylene as a possible rival of coal gas; and the sooner this is realized, the better will it be for the future of this brilliant illuminant.

Abroad, where coal gas is dear, it is possible, by taking the price of acetylene in the holder and comparing it with distributed coal gas, to make acetylene out to be, light for light, as cheap as the latter when consumed in a flat-flame burner; but even this method of calculation breaks down before the high light emissivity of the incandescent mantle. It is in districts where no coal gas exists that the true field for acetylene is to be found; and here its ease of generation, and the beauty of its light, makes it a pleasant companion after the greasy dimness of the candle, or the smell of the oil-lamp.

When I first attempted to burn acetylene, I used the Bray nipples which could be had on the market, and found that I obtained very high illuminating effects, and could, for a time, continue the combustion in a satisfactory way by using 3 or 4 inches pressure at the burner. This high pressure was, however, undesirable; and I then devised a cubic foot burner in which, by drilling the union jet holes of very small size and at a more obtuse angle, I was able to burn the gas at 1 inch pressure. About this period, also, Bray made some specially small tips for use with acetylene. Both these nipples answered extremely well for a time, and developed from 30 to 36 candles per cubic foot of gas. But they both had the same weakness, and after a few hundred hours began to smoke. As a smoking acetylene flame covers everything in a room with a thick deposit of soot in a very short space of time, such burners were manifestly not fitted for the work they had to perform.

The trouble generally commenced with a filiform growth of carbon appearing at the nipple, which quickly distorted the flame and caused a cloud of soot flakes to descend. If the burner was cleaned and relighted, the trouble began again in an hour or two; and the only thing to be done was to replace the nipple by a new one. If the nipple had been burning some time, and was then removed and broken, it was found to be carbonized for some depth into the material; showing that a liquid hydrocarbon had soaked into the substance, and had been split up there by the heat, with deposition of carbon. The generally accepted idea was that the heat of the nipple polymerized some acetylene to benzene, and that this forming a drop did the mischief; and efforts to keep the burner cool were looked upon as a likely direction in which to search for success.

While these troubles were going on in England, attempts had been made in America to use acetylene diluted with a certain proportion of air, which permitted it to be burnt in ordinary flat-flame nipples; but the danger of such admixture being recognized, nipples of the same class as those used in England were employed, and the same troubles ensued.

In France, single jets made of glass were first employed; and then Risener and Luchaire, Ragot, and others, made burners in which two jets of acetylene coming from two tubes spaced some little distance apart should impinge and splay each other out into a butterfly flame. Soon after Bullier introduced the idea of sucking air into the flame at, or just below, the burner-tip; and at this juncture the Naphey or Dolan burner was introduced in America—the principle employed being to use two small and widely separated jets instead of the two openings of the union-jet burner, and to make each jet a minute bunsen in which every jet of acetylene dragged in from the base of the nipple enough air to surround and protect it, while burning, from contact with the steatite.

These burners were hailed with delight, and their success led to their being pirated right and left. But although they mark a very great improvement, and will burn for several hundred hours without smoking (unless in a fit of false economy the user insists on turning them down and leaving them for an hour or so as two small separate flames, in which case they generally start smoking on being turned on again), the trouble is by no means got over; and a Naphey burner will often be found smoking as heartily as one of its more humble brethren. The fact is that the cause of smoking is to be found quite as much in the generator as in the nipple; and over-heating during generation is undoubtedly a prime factor in this worrying phenomenon.

If smoke or tar vapour be examined under a high microscopic

power, it is seen that it consists of minute vesicles or bubbles in a marvellously active condition of movement, and fulfilling, in a most perfect manner, the conception one forms of molecular motion. Ever bombarding each other, but never colliding, these small vesicles, filled with gaseous matter, continue their career until some mechanical action bursts them, and deposits the minute trace of liquid which formed the skin of the microscopic balloon.

It is for this reason that the most successful forms of washer for extracting tar during the manufacture of gas consist of fine jets or orifices through which the gas passes at considerable velocity and comes in contact with a baffle which breaks up the vesicles; and anyone with experience in carburetted water-gas making knows the trouble that arises from filiform growths of carbon when, owing to an insufficient temperature in the cracking and superheating chambers, the carburetted gas contains vapours instead of permanent gaseous products.

When acetylene has been made in a generator at an undue temperature, it carries with it benzene vapour, which, as it commences to condense, assumes this vesicular form; and on coming to the extremely minute holes which form the appertures of the burner, the mechanical scrubbing which it encounters causes the breaking up of the vesicles and the deposition of the benzene, and other hydrocarbons held in suspension by benzene, which soak into the steatite and carbonize. The presence of finely divided carbon has a great effect in determining the decomposition of the acetylene itself, so that a rapid growth of carbon takes place at the burner. Then no ordinary clearing of the deposited carbon from the exterior will ever make the nipple fit for constant use again, as the catalytic action of the carbon deposited in the pores of the steatite, and which cannot be got rid of, causes the deposition of a fresh supply of carbon. Whilst, when the benzene vapour gets past the nipple and burns, as it requires three times as much air as acetylene, it often starts the flame smoking from this cause.

The impurities, however, in acetylene, other than vapours, also play a certain part in the choking of the burner, as if there be much phosphuretted hydrogen in the gas, a small quantity of phosphoric acid is apt to be deposited in the burner-nipple and helps to distort the aperture, while silica from siliciuretted hydrogen has the same effect.

It will be found with experience that the prevention of smoking in a burner will be overcome quite as much by attention to the temperature in the generator as to the burner itself; and where a generator which gives over-heating is in use, a well-arranged scrubbing apparatus that would get rid of the benzene from the gas would be found a distinct advantage in stopping burner troubles, while, when proper purification is introduced, the difficulty will be found to have been practically solved.

At the Acetylene Exhibition held in Berlin early this year, all the newest forms of burner were shown; and the best burners of each class were tested at the Imperial Physical Institute both for consumption and light-giving power. It was found, after 18 hours burning, that several had to be eliminated on account of their then commencing to smoke; 30 hours proved fatal to another batch; while a few only continued giving satisfactory results after that period. This shows that the same troubles which have been rife in England have been equally marked on the Continent.

The results also obtained as to the candle power of these burners fully bear out the figures which I have obtained. It may be of interest at this point to record the candle power of some of the many burners which I have personally tested.

Date.	Name of Burner.	Pressure. Inches.	Gas Consumed. Cub. Ft.	Light. Total.	Produced in Candles. Per Foot.	Per 5 Ft.
1894.	Lewes	1·75	1·02	32·82	32·17	160·8
,,	Bray No. 000	2·00	1·85	64·00	34·59	172·9
1895.	Bray No. 4 (acetylene)	1·50	0·50	12·00	24·00	120·0
1896.	Naphey or Dolan	2·00	0·60	16·00	26·60	133·0
1897.	Falk-Naphey	2·50	0·50	11·00	22·00	110·0
,,	,, ,,	2·50	0·75	20·00	26·00	130·0
1898.	,, ,,	2·50	1·00	34·00	34·00	170·0
,,	Nurnberg	2·50	1·00	36·00	36·00	180·0
,,	Hera	2·50	0·80	26·00	32·50	162·5
,,	Ideal	2·50	0·75	20·00	26·50	132·5
,,	Billwiller	3·00	1·00	40·00	40·00	200·0

These really represent the best results obtainable by the combustion of acetylene under domestic conditions.

The Dolan or Naphey tip was a great advance at the time when it was introduced; but the arms which carried the tips were made of metal, and these were perpetuated in the first batch of piracies made. The effect of heat after a time is to slightly distort these arms, thus throwing the two jets of gas out of line. This trouble has now been remedied by making the arms of the burner entirely in steatite, which, though adding to the cost, is a distinct advantage.

The incandescent mantle has made such a revolution in coal-gas lighting that it is not surprising that attempts should have been made to adapt acetylene for the purpose; and the first thing which had to be done when taking steps in this direction was to construct an atmospheric burner which would satisfactorily consume the gas.

One would expect that acetylene, when consumed in an atmospheric burner, would give an excessively hot flame, not only on account of its composition, but also because of its endothermic character. Le Chatelier calculates that the temperature of a non-luminous acetylene flame will range from 2100 to 2420° C.; the temperature, of course, varying with the ratio of acetylene to air, as shown in the following calculations:—

Percentage of Acetylene.	Percentage of Air.	Temperature, Deg. C.
7·40	92·60	2420
12·90	87·10	2260
17·37	82·63	2100

In order to make a bunsen burner for acetylene, the tube has to be extremely narrow, and it is even then found to be very liable to flash-back; while it needs a high pressure in order to bring about satisfactory combustion of the gas with an absolutely non-luminous flame. One of the chief difficulties which has to be overcome is due to the range over which mixtures of air and acetylene are explosive, and which we have seen lies between the limits of 3 per cent. and 82 per cent. of acetylene; and it must also be remembered that the velocity of the explosion of acetylene, when mixed with air, is greater than with a mixture of air and coal gas. The propagation of the explosive wave down the burner tube cannot be satisfactorily stopped by the ordinary device of using wire gauze, on account of the low igniting point of acetylene and air mixtures; while if high pressures are used, so that the rate of flow shall be greater than the velocity of propagation downwards, more air is sucked in by the uprush of the gas, and the velocity of the explosion is again increased.

The best results have been obtained by taking a bunsen burner in which a constriction in the air-tube creates a high velocity at that point which, on the principle of the Smithell's flame separator, prevents the propagation downwards just at that point.

Le Chatelier has shown that the rate of propagation of an explosive mixture of air and acetylene depends upon the diameter of the tube through which the wave is being propagated; and he has worked out the limits between which the explosive wave would pass through tubes of certain diameters—

Diameter of Tube. Inches.	Explosion. Lower Limit. Per Ct. Acetylene.	Explosion. Upper Limit. Per Ct. Acetylene.
1·57	2·9	64
1·18	3·1	62
0·79	3·5	55
0·24	4·0	40
0·16	4·5	25
0·08	5·0	15
0·03	7·7	10
0·02	0·0	0

It will be seen that in a tube 0·02 inch, or 5 mm. in diameter, the propagation of the explosive wave ceases.

These investigations have been used as a basis upon which to construct acetylene burners for heating purposes; and burners have been made by the Allgemeine Carbid and Acetylen-gas Company, of Berlin, in which, by means of constricted tubes, satisfactory consumption is ensured; and it is found that the diameter of the tube at the constriction must be in a definite proportion to the particular mixture of air and acetylene consumed, as the more air employed the greater must be the constriction in the strangulated portion of the tube. Such burners have a flame which is very valuable for heating purposes, and give a very intense temperature.

The same Company have also used these burners with incandescent mantles of somewhat different shape and composition to those ordinarily employed, and state that the photometric result is 30 to 40 per cent. higher than that obtained by the combustion of pure acetylene alone. I have quite lately been experimenting with an acetylene bunsen, and get much higher results than these, as, with a Welsbach No. 2 mantle, I have obtained as much as 90 candles per cubic foot of acetylene consumed; and as far as I have gone, the mantle appears to be hardened and strengthened by the intense heat to which it is subjected. But it yet remains to be seen how the life of the mantle is affected by the intense temperature of the flame.

Acetylene atmospheric burners are now also employed for heating, cooking, and metallurgical operations on a small scale; and with a reduction in the price of the gas, these uses for it will undoubtedly open up a wide field.

The value of acetylene in photographic work is now universally recognized; and Mr. W. H. Walmsey has arrived at its relative value, as compared with the ordinary sources of light, by determining the time needed to fully expose carefully prepared plates, with the following results:—

	Seconds.
Direct sunlight	1
Acetylene, 1 cubic foot burner	3
Diffused daylight reflected from mirror	12
Incandescent mantle	24
Coal gas Oil gas. Oil lamp	240

It is also, to a certain extent, being used for projection work; but it is not so well suited for this, as, in common with multiple wick oil-lamps and incandescent mantles, the flame offers too large a surface of illumination.

M. Molteni has attempted to determine the projection value of various illuminants by a photometric process in the following way: The measurements were made with an ordinary lantern, the stage of which carried an opaque card in which was cut an aperture 0·7 centimetre square; and the distance of the lantern from the screen was such that each side of the square on the screen measured 1 metre. The screen was replaced by a disc of paper; the opposite side being illuminated by a standard lamp

burning 42 grammes of oil per hour. The distance of the lamp was varied in order that equality of illumination might be obtained on the screen; and the photometric values of the lights were determined from the distance of the lamp.

Multiple-wick lamp	1·00
Incandescent gas, No. 2 burner, no reflector	1·00
Acetylene—	
No. 1 burner, no reflector	1·06
No. 2 „ „	1·70
No. 3 „ „	3·20
No. 4 „ „	4·10
No. 5 „ „	4·50
Limelight—	
Alcohol and oxygen	5·80
Oxy-hydrogen	16·60
Etho-oxygen	18·50
Electric incandescent lamp—	
32-candle power	0·68
50 „ vertical	0·93
50 „ horizontal	0·93
Focus 100	3·82
Arc lamps—	
7 ampères	39·03
10 „	75·61
12 „	86·50
15 „	117·61
20 „	160·80

Carbide will probably some day become an important factor in the transmission of power, as a cubic foot of solid carbide would weigh 62·26 kilos, or 137 lbs.; and if of commercial purity, it would yield 685 cubic feet of acetylene having a thermal value of nearly 232,215 calories.

In practice, however, the weight of carbide which can be got into a cubic foot space is dependent on the size to which the material is broken; and with the ordinary commercial carbide, a fair average would be 80 lbs. per cubic foot, yielding 400 cubic feet of acetylene gas, with a thermal value of 139,600 calories. It is at once manifest that solid carbide is as economical a method of transporting acetylene as if liquid acetylene itself were employed, as the liquid would only yield about 400 times its own volume of gas; and the carbide has the advantage of being practically safe in transit.

There are several people at present working on the utilization of acetylene for motors; but there are many difficulties to be overcome before this is successfully accomplished. The deposition of carbon when the air supply is insufficient, and the violence of the explosion, are troublesome factors to deal with.

The trouble of completely consuming acetylene without smoking in the early days of its inception caused Dickerson and Sukert to attempt the combustion of acetylene diluted with air; and in 1894 it was in this way that the gas was consumed. Not only did the cooling action of the nitrogen lead to a considerable decrease in the illuminating power of the acetylene so diluted, but, as will have been seen from the experiments of Gerdes and others, a very serious risk was incurred; it becoming merely a question of the breadth of the delivery-tubes and the rate of flow of the gas, whether an explosive wave was propagated back to the mixing machine or not. It was on account of the danger of this that the process of burning it in America was abandoned. The idea has, however, cropped up from time to time since; and both in France and Holland it has been, to a certain extent, used on a practical scale. Even at the present time, an attempt is being made in Manchester to introduce a process by which acetylene can be so diluted with air as to burn in an ordinary Bray burner.

The danger of diluting acetylene with air being so manifest, attempts have, from time to time, been made to dilute it with other gaseous material. In 1895, Bullier took out a patent for "Improvements in Carburetting Air and Gas," in which he claims the use of acetylene for the enriching of water gas; while having then, apparently, found that acetylene was useless for this purpose, he, later on in the same year, took out a second patent for diluting it with nitrogen. It was about this time, also, that Mr. Gerdes commenced his experiments upon the enrichment of oil gas with acetylene, which have borne such ample fruit on the Continent, and showed that when oil gas is enriched with 25 per cent. of acetylene, a valuable increase in its illuminating power is obtained, without any danger of explosion of the mixture owing to heat or shock. This mixture is now employed to a very large extent on the Prussian Railways. The quantity of carbide already used this year for the purpose has reached a total of 3000 tons; and it is computed that before the end of next year, 10,000 tons per annum will be needed.

In consequence of the great Continental success of this admixture, application was lodged at the Home Office to sanction such a mixture in England, under the ordinary railway carriage cylinder pressure of 10 atmospheres. The safety of the mixture, and of mixtures considerably richer in acetylene, was completely established by a series of tests carried out in the presence of the Home Office officials; and in consequence, by an order of the Secretary of State, dated March 28, 1898, a mixture of oil gas with 20 per cent. of acetylene is allowed to be used at a pressure not exceeding 150 lbs. on the square inch.

In order to determine the increase in illuminating power given by various percentages of acetylene in oil gas, and whether the mixture could be employed with economy, the following experiments were instituted. Oil gas containing 20 per cent. of acetylene was compressed into a cylinder under the pressure of 10 atmospheres; some of the original oil gas being also compressed in a second cylinder to the same pressure. Both cylinders were then blown off to 5·8 atmospheres; and the illuminating power of each was taken under identical conditions. The burner used was a 0·40 litre one, and the results were as follows:—

Pressure.	Gas Consumption.	Illuminating Value. Oil Gas.	Oil Gas and Acetylene.
5-8ths	1 c. ft.	74	15·6

An analysis of the gas showed that the mixture contained 22 per cent. of acetylene, although only 20 per cent. was originally added; the increase being due to the loss of some of the oil gas in which, under pressure, some of the vapours of benzene and toluene condense to the liquid state. Working from these figures, it will be seen that the addition of 22 per cent. of acetylene caused an increase of illuminating power of 110 per cent., or 100 per cent. with 20 per cent. of acetylene.

The original oil gas, and the mixture of oil gas with acetylene, were next determined photometrically in an ordinary railway carriage lamp, at angles below the horizontal, on the Dibdin radial photometer—

Oil Gas.

Angle.	Pressure.	Gas.	Candles.	Candles per Cubic Foot.
Horizontal	1 inch	2 c. ft.	7·4	3·7
10	„	„	8·0	4·0
20	„	„	8·2	4·0
30	„	„	8·2	4·1
40	„	„	8·2	4·1
50	„	„	8·0	4·0
60	„	„	7·6	3·8
70	„	„	7·8	3·9
80	„	„	8·0	4·0

Average candles per cubic foot, 3·9.

Oil Gas and Acetylene.

Angle.	Pressure.	Gas.	Candles.	Candles per Cubic Foot
Horizontal	1 inch	2 c. ft.	17·0	8·50
10	„	„	17·0	8·50
20	„	„	17·5	8·75
30	„	„	18·0	9·00
40	„	„	17·0	8·50
50	„	„	17·0	8·50
60	„	„	17·0	8 50
70	„	„	16·5	8·25
80	„	„	16·5	8·25

Average candles per cubic foot, 8·5.

Showing that the addition of 20 per cent. of acetylene increases the illuminating power of the oil gas by over 110 per cent., at all angles. These figures prove, therefore, that adding 20 per cent. of acetylene doubles the illuminating value of the oil gas.

With regard to cost, as we have before seen, acetylene, at the present price of carbide, will cost about £1 18s. to £2 per 1000 cubic feet in the holder; and 200 cubic feet will accordingly cost 7s. 8d. The compressed oil gas costs from 6s. to 12s. per 1000 cubic feet. With oil gas at 8s. per 1000 cubic feet, 800 cubic feet will cost 6s. 5d. So that the total cost of 1000 cubic feet of the enriched gas is 14s. 1d. But as the illuminating value of the mixture is double that of the plain oil gas, there is an economy of 1s. 11d. per 1000 cubic feet. As the oil gas is dearer, the saving will be greater; and *vice versâ* with cheap oil gas the addition of acetylene would not pay. With oil gas at 6s. 6d. per 1000 cubic feet, there is practically no difference; but the advantages accruing from the use of acetylene would make the mixture more desirable than the plain gas. Among these advantages are that the cylinders would last for double the length of time they would with the oil gas with the one charge; and there would be no formation of liquid hydrocarbons, due to compression, with the consequent revaporizing when the pressure is reduced—causing inequality in the illuminating power.

The whole question of diluting acetylene with other gases has had very great interest for me; and I have made many experiments in order to determine how it is that, when 10 per cent. of acetylene is added to a diluent such as blue water gas, carbon monoxide, or even hydrogen, the resulting mixture is practically non-luminous. I have worked out the enrichment value for acetylene for all gases which might be employed for its dilution. I soon discovered from these experiments that methane is the only diluent which sustains the illuminating power of the acetylene when mixed with it in small proportions; and the fact that the same phenomenon is observable in comparing the illuminating power of mixtures of gases containing only some 30 per cent. of methane, gives at once a clue to the methods which must be adopted in making a diluting gas for acetylene.

It is perfectly obvious that in many places it would be a great advantage to have an illuminating gas of about 20-candle power for general distribution in the same way as a good coal gas could be used, if such a mixture could be produced at a price comparing favourably with coal gas under the same conditions. In order to do this, although it would be impossible to use pure methane as the diluent for acetylene, on account of the cost of its production, it is quite easy to make a diluting gas which shall contain 30 per cent. of methane at a comparatively low rate.

In order to make this, a slightly modified form of water-gas generator is employed; and the fuel having been blown up to incandescence by an air-blast, tar, creosote oil, heavy oil residues, or practically any waste liquid hydrocarbon, is injected into the body of the incandescent fuel by a steam injector or atomizer. If these hydrocarbons were allowed to run into the fuel by themselves, they would simply be burnt up to carbon and hydrogen. But steam being injected with them, the steam is decomposed by the fuel with the formation of water gas

which to a certain extent envelops the hydrocarbon; and instead of its undergoing complete decomposition, it is broken down to methane and hydrogen and mingles with the water gas, while any residual carbon is left behind in the fuel. It is quite possible by such means to make a diluting gas containing—

Hydrogen	45
Carbon monoxide	15
Methane	30
Unsaturated hydrocarbons	5
Carbon dioxide and nitrogen	5
	100

This gas costs from 8d. to 10d. per 1000 cubic feet, and has an initial illuminating value of about 10 to 12 candles. On mixing with it 5 per cent. of acetylene, a gas having an illuminating value of 18 to 20 candles is obtained, which, being a mixture of perfect gases, gives no trouble as regards layering, and which, having the same specific gravity and illuminating value as coal gas, can be distributed and burnt in precisely the same way.

It is also found that mixtures of this gas with 50 per cent. of acetylene are not detonated when compressed for railway carriage lighting by any temperature which it would be possible to attain in the cylinder; and it seems that this method of utilizing acetylene is pre-eminently the one which promises for it the largest and most remunerative future.

In concluding this course of lectures, I am impressed by the feeling that the limited time at my disposal has prevented me doing full justice to my subject. I should have far preferred a course of forty rather than four lectures in order to deal with the many important points and side-issues which, of necessity, have been omitted. I leave my subject with the sincere hope that, as time wears on, those points which appear to us now to be difficulties will be made abundantly clear; and that in the future cheapened carbide will enable this beautiful hydrocarbon to take its proper place in the foremost ranks of our illuminants.

SOCIETY OF CHEMICAL INDUSTRY.

A Meeting of the London Section of the Society was held on the 5th inst., at Burlington House, under the presidency of Mr. Boverton Redwood. After the reading and discussion of a communication by Colonel W. J. Engledue on "Ozone and its Commercial Applications," Mr. Arthur Marshall read two short papers, one of which, on "An Improved Apparatus for the Estimation of Carbonic Acid in Minerals, &c.," was of interest to gas engineers who use lime as a purifying material.

The improved apparatus was a modification of the well-known Scheibler's calcimeter, which is unreliable for any but a very limited class of work. Mr. Marshall uses an evolution flask or bottle of very small dimensions, and in it treats a weighed amount of the material under examination with concentrated hydrochloric acid. He thus avoids the necessity of adding to the volume of carbonic acid collected a certain volume to compensate for the absorption of that gas by *dilute* hydrochloric acid. This correction for absorption is one of the most objectionable features of Scheibler's apparatus; but, on the other hand, the tension of the vapour of concentrated hydrochloric acid cannot be altogether ignored. In place of receiving the evolved carbonic acid in a rubber bladder, the expansion of which forces the confined air by which it is surrounded to depress a column of water in a measuring tube to an extent corresponding to the volume of carbonic acid evolved, Mr. Marshall collects the carbonic acid over petroleum, in which he believes it is absorbed to an inappreciable degree. He had not, however, learnt what actually was the coefficient of absorption of the gas in the petroleum he employed. He immersed the evolution flask in a vessel of cold water, in order to prevent the heat of the reaction causing expansion of the volume of the gas; but he did not surround the measuring tube with a water-jacket. An attachment to the glass tube which leads from the evolution flask to the measuring tube, renders unnecessary the reading of a thermometer and barometer for the correction of the volume of the gas, in the same manner as Mr. Vernon Harcourt's aerorthometer and Professor Lunge's gasvolumeter are used in other branches of analysis. This attachment seems to be the most valuable improvement on Scheibler's apparatus introduced by Mr. Marshall. The improved instrument may prove useful to gas engineers who wish to ascertain the approximate amount of calcium carbonate in the lime they employ.

A note by Mr. I. Redwood on an action of acetylene on platinum was, for lack of time, taken as read. The author appears to have observed the destructive effect of the intensely hot acetylene flame on platinum utensils. This action renders acetylene almost useless as a gas supply for bunsen burners in a number of laboratory operations in which platinum crucibles are used.

Mr. Walter Hunter on the London Water Supply.—At one of the meetings of the Society of Arts after Christmas, Mr. Walter Hunter, the Engineering Director of the Grand Junction Water Company, and Joint Engineer with Mr. Reginald E. Middleton to the Staines Reservoirs Committee, will read a paper on "London Water Supply."

THE THEORY OF THE WATER-GAS PROCESS.

The following is an abstract-translation of a contribution by Dr. H. Luggin, of Carlsruhe, on the above subject to a recent number of the "Journal für Gasbeleuchtung."

The gas which is produced by the action of steam on incandescent carbon can vary very greatly in composition. In order to secure a high yield of the combustible gases, carbonic oxide and hydrogen, it is necessary in the first place that the steam should have ample opportunity for action on the carbon. Even when this condition is fulfilled, a good result will not be achieved unless the temperature of the carbon is kept sufficiently high. Practical men will be interested to learn that the first principles of theoretical chemistry afford a basis for the establishment of quantitative relations between the temperature of the generator and the composition of the gas produced in it.

Certain theoretical considerations recently set forth by Hoitsema, which are of value for the purpose of the present paper, will be first of all detailed; then certain experimental facts collected by Hoitsema in support of his theory will be recorded; and finally his theory will be applied to the present case. We shall thus be in a position to apprehend why the two evils—viz., imperfect decomposition of the steam in the generator, and a large proportion of carbonic acid in the water gas made—invariably are unavoidable consequences of too low a temperature in the generator.

The theory of Hoitsema deals with the reaction between carbonic acid and hydrogen whereby carbonic oxide and steam are formed; and the converse reaction between carbonic oxide and steam, by which carbonic acid and hydrogen are produced. Both reactions take place at a high temperature; and Horstmann has conjectured an equilibrium expressed by the balance:

$$CO_2 + H_2 \rightleftharpoons CO + H_2O$$

In a mixture of the four gases—carbonic acid, hydrogen, carbonic oxide, and steam—in a state of incandescence, both reactions must always take place simultaneously. Every moment a certain number of molecules of carbonic acid and hydrogen are converted in the manner indicated by the arrow $\rightarrow$; while simultaneously a certain number of molecules of carbonic acid and hydrogen are formed according to the change indicated by the arrow $\leftarrow$. A stable state or equilibrium will result when simultaneously the same number of molecules are converted both ways; and the composition of the mixture remains unaffected by the conversion. Hoitsema's investigation elucidates this equilibrium; and shows how it is dependent on temperature. The water-gas process consists merely in the phenomena which occur between incandescent carbon and steam, and the products which result from the interaction of these two bodies—viz., carbonic acid, hydrogen, carbonic oxide, and steam. These four gaseous products, however, are in the state of equilibrium referred to above when they leave the generator; and hence Hoitsema's theory possesses importance for the water-gas process. The first question is how to ascertain the quantitative relations which must obtain when equilibrium is found in the gaseous mixture at a given temperature.

Let us, in the first place, suppose that the gas contains a gramme-molecule of hydrogen per litre, or that the concentration of the hydrogen ($C._{H_2}$) is unity. At the same time there may be m gramme-molecules of carbonic acid contained in a litre of the gas, or the concentration of the carbonic acid ($C._{CO_2}$), will be equal to m. The frequency with which the molecules of carbonic acid react on the molecules of hydrogen will clearly be proportional to their number, and, therefore, proportional to $C._{CO_2}$. If, now, we suppose that the concentration of the hydrogen in the gas is changed so that $C._{H_2} = n$, while $C._{CO_2}$ remains unchanged at m, then the reaction between the molecules of hydrogen and the molecules of carbonic acid will clearly be n times as frequent as before. Consequently, the amount m of gramme-molecules of carbonic oxide and water which are formed by the reaction in unit time will be found to be proportional to the product $C._{CO_2} \times C._{H_2}$, or—

$$m = C._{CO_2} \times C._{H_2} \times k_1$$

where k_1 is a number which expresses the velocity of reaction for carbonic acid and hydrogen. But if equilibrium is maintained in the mixture, then at the same time as these m molecules of carbonic oxide and water are formed, there must conversely be formed m molecules of carbonic acid and hydrogen. The latter molecules are formed by the converse reaction between the molecules of water and carbonic oxide in the mixture, thus:

$$m = C._{CO} \times C._{H_2O} \times k_2$$

where k_2 represents the velocity of the reaction between carbonic oxide and water, and $C._{CO}$ and $C._{H_2O}$ the concentrations of the carbonic oxide and water vapour respectively in the mixture. These expressions may now be put in an equation:

$$C._{CO_2} \times C._{H_2} \times k_1 = C._{CO} \times C._{H_2O} \times k_2$$

or—

$$\frac{C._{CO} \times C._{H_2O}}{C._{CO_2} \times C._{H_2}} = \frac{k_1}{k_2} = K \quad (1)$$

This relation may be expressed in words thus: The product of the concentrations of the carbonic oxide and of the water vapour, divided by the product of the concentrations of the carbonic

acid and of the hydrogen, is equal to a certain value K, which value is the equilibrium-constant of the gaseous mixture.

Knowledge of the equilibrium-constant affords much valuable light on the composition of the gaseous mixture. For example, if the product of the concentrations of the carbonic acid and of the hydrogen ($C.CO_2 \times C.H_2$) in a mixture is known, then the above relation gives also the value of the product of the concentrations of the carbonic oxide and of the water vapour ($C.CO \times C.H_2O$); and thus it may be seen that the concentration of the water vapour present in the mixture must be so much the less the more carbonic oxide there is present. We may in anticipation draw a conclusion with reference to the water-gas process—viz.: At temperatures between 1000° and 1100° C. (1832° and 2012° Fahr.), the equilibrium-constant K has an average value 1·8; and at the same time the concentrations of hydrogen and carbonic oxide are of the same order of magnitude, or, roughly, $C.CO = C.H_2$. Equation (1) then takes the form—

$$1{\cdot}8 = \frac{C.H_2O}{C.CO_2}$$

which signifies that the concentration of the undecomposed water-vapour is about double as great as that of the carbonic acid in the generator gas.

Before giving numerical evidence of the existence of an equilibrium in the heated gaseous mixture of carbonic acid, carbonic oxide, water vapour, and hydrogen, the influence which temperature exerts on the equilibrium-constant K, and therefore on the composition of the gaseous mixture must be discussed. Those chemical processes which are attended by an absorption of heat are associated with a rising temperature; while, conversely, reactions in which heat is liberated for the most part occur at low temperatures. Phenomena of dissociation are, however, commonly observed at high temperatures, for those bodies which are formed at low temperatures with liberation of heat are decomposed with absorption of heat at sufficiently high temperatures. This law is thermo-dynamically well established; and it is valid for the case of the equilibrium

$$C.CO_2 + C_{H_2} \rightleftharpoons C.CO + C_{H_2O}$$

The reaction indicated by the upper arrow is associated with a considerable absorption of heat. For a temperature of 15° C. (59° Fahr.), Berthelot found an absorption of 10,100 (gramme) calories per gramme-molecule, and therefore:

$C.CO_2 + C.H_2 = C.CO + C.H_2O -$ 10,100 (gramme) calories.

As the reaction indicated by the upper arrow is associated with absorption of heat, it will proceed the more briskly the higher the temperature is; while the converse reaction, which is attended by liberation of heat, will then take place to a diminishing extent. The product of the concentrations of the carbonic oxide and of the water vapour ($C.CO \times C.H_2O$) will thus continually attain higher values as the concentration of these two bodies increases; while, on the other hand, the product of the concentrations of the carbonic acid and of the hydrogen ($C.CO_2 \times C.H_2$) diminishes as the temperature rises. Therefore the constant of the reaction

$$K = \frac{C.CO \times C.H_2O}{C.CO_2 \times C.H_2}$$

will increase as the temperature rises. It follows that the value of K will finally reach infinity, or that ($C.CO_2 \times C.H_2$) will, at the highest temperature, become zero, even though it cannot be demonstrated that the absorption of heat becomes continually more trifling as the temperature t increases, until it finally approaches *nil*, and that the reaction at yet higher temperatures would be attended by liberation of heat. These variations in the heat q of the reaction by which carbonic oxide and water are formed from carbonic acid and hydrogen, find expression in the following formula:

$$q = 10111 - 0{\cdot}72\,t. - 0{\cdot}00101\,t^2$$

[The peculiar variations in the heat of the reaction which are observed as the temperature rises, are due to the want of uniformity in the specific heats of the several constituents. The mean specific heats of hydrogen and of carbonic oxide, according to Mallard and Le Chatelier, are given by the expression $4{\cdot}76 + 0{\cdot}00122\,t$; while the similar values for carbonic acid and water vapour are respectively $6{\cdot}50 + 0{\cdot}00387\,t$ and $5{\cdot}78 + 0{\cdot}00286\,t$. Therefore, heating one molecule of carbonic acid and one molecule of hydrogen from zero to t will require $0{\cdot}72\,t + 0{\cdot}00101\,t^2$ calories more than will the heating of one molecule of carbonic oxide and one molecule of water through the same range of temperature. At zero, the formation of one molecule of carbonic oxide and one molecule of water from one molecule of carbonic acid and one molecule of hydrogen requires 10,111 calories. Let us conceive the conversion to proceed thus: The carbonic acid and hydrogen are first heated from 0° to t°; they are then converted to carbonic oxide and water vapour; and these two gases are then cooled to 0°. The heating of the mixture of carbonic acid and hydrogen requires about $0{\cdot}72\,t + 0{\cdot}00101\,t^2$ calories more than the cooling of the carbonic oxide and water affords; and therefore the heat absorbed by the chemical change when the gases are heated to t°, will be less by $0{\cdot}72\,t + 0{\cdot}00101\,t^2$ than the similar absorption of heat at 0°.]

When the temperature t is equal to 2825° C. (5117° Fahr.), q becomes = 0. At higher temperatures q has a negative value, which implies that the reaction is then attended by liberation of heat. Exactly in correspondence with the changes in the heat of the reaction, the number of molecules of hydrogen and carbonic acid which are converted into water and carbonic oxide continues to increase with rise of temperature so long as t is less than 2825° C., for heat is absorbed in the process of conversion. But, on the other hand, when t is above 2825° C., the formation of molecules of hydrogen and carbonic acid from molecules of water and carbonic oxide increases as the temperature rises; and this change is then attended by an absorption of heat. The facts may in other words be expressed thus: The equilibrium-constant K increases with temperatures rising from 0° to 2825° C.; but above the latter temperature, it begins to decrease again.

These theoretical conclusions are supported in the first place by the results of Horstmann's researches on the detonation of mixtures of hydrogen and carbonic oxide with oxygen. The aim of his researches was to ascertain how an insufficiency of oxygen is distributed between the hydrogen and carbonic oxide on explosion. A mixture of this kind, after the explosion, consists of hydrogen, carbonic oxide, carbonic acid, and water in proportions which correspond with the highest temperature attained by the explosion. Cooling takes place so rapidly after the explosion that the state of equilibrium then reached does not appear to be appreciably affected. The heat of the reaction by the explosion is, however, known; and the specific heat of the gaseous mixture can be computed from the specific heats of its several components. From these data the highest temperature attained can be found, as it is equal to

$$\frac{\text{the heat of the reaction}}{\text{the specific heat.}}$$

Analysis of the gaseous mixture which remains after the explosion gives the concentrations of each of the four components; and hence the constant of the reaction K, corresponding to the temperature in question, may be found from the equation—

$$K = \frac{C.CO \times C.H_2O}{C.CO \times C.H_2}$$

The various series of researches distinctly corroborate the theoretical conclusion that the equilibrium-constant increases up to a certain temperature, and then again decreases. For example, the following results are given by Hoitsema:

K .. =	4·96 ..	6·01 ..	6·49 ..	6·27 ..	5·78 ..	5·00
Temp. °C. =	2174 ..	2454 ..	2762 ..	2598 ..	3057 ..	3475

The average of the whole series of experiments shows the maximum value of K to be 6·25; and this corresponds with the temperature 2670° C. The temperature already found, by calculation, for the maximum value of K was 2825° C.

Hoitsema also substantiates his theory by reference to the researches of Messrs. Macnabe and Ristori,* who investigated the composition of the gases formed when various solid explosives were fired. These gases contained carbonic acid, carbonic oxide, hydrogen, and water vapour in admixture with nitrogen and a little methane. The concentrations of the first four constituents afford a means of calculating the constant of the reaction. The determination of the temperatures for each case is, however, not very reliable, because the gases are under high pressures and cool quite slowly. The highest temperature attained falls within the same range as in Horstmann's researches—the value of the equilibrium-constant (K) fluctuates about 4·2; and indicates the influence of temperature on the equilibrium.

Hoitsema concludes that the results of the researches made on explosives present a study of the equilibrium of the reaction between 3500° and 1750°; and that the latter temperature approaches those which can be maintained constant for a long time, and at which the equilibrium of the reaction is made to take quite another course. Dr. Bunte drew the author's attention to researches made at Carlsruhe by Herr Harries, of which the results were published in 1894†. In these researches, steam was passed through a heated porcelain tube in which were pieces of charcoal. The amount of steam introduced, the composition of the gas which issued from the tube, and the temperature of the tube, were ascertained. The significance of these researches lay in the demonstration they afforded of the enormous influence which the temperature of the generator exerts on the composition of the gas produced. Tolerably complete decomposition of the steam first occurs at temperatures above 900° C. The appended table presents the results of the observations in a form which facilitates the direct calculation of the equilibrium-constant. The gaseous mixture consists of the four substances with which the equilibrium studied by Hoitsema is concerned. The concentrations of the carbonic oxide, C_{CO}, water, C_{H_2O}, carbonic acid, C_{CO_2}, and hydrogen, C_{H_2}, are proportional to the volumes given in the table; and it is therefore easy to calculate the equilibrium-constant K according to equation (1), and this constant calculated thus is given in the eighth column. It refers to temperatures ranging from 670° C. to 1130° C. The rate of flow of the gas was much greater at the high than at the low temperatures. It will be useful to observe whether the values of K, based on these researches, are in harmony with the maximum value of the equilibrium-constant of 6·25 found by Hoitsema for

* Proceedings of the Royal Society, 1894, 56, p. 8.

† "JOURNAL," Vol. LXIII., p. 484.

a temperature of 2825° C.; and whether they correspond with the temperatures at which the formation of water gas occurs.

Temperature.		Volumes per Cent. of the Products.				Rate of Flow per Hour of the Gas Formed.	Value of K Deduced from the Results of the Observations.	Value of K Computed from Theoretical Considerations.
°C.	°F.	H.	CO_2.	CO.	H_2O.	Cub. Ft.		
674	1245	8·41	3·84	0·63	87·12	1·91	1·70	0·49
758	1396	22·28	9·23	2·67	65·82	3·81	0·85	0·70
838	1540	28·68	11·29	6·04	54·09	7·76	1·01	0·93
838	1540	32·77	12·11	7·96	47·15	6·95	0·94	0·98
861	1582	36·48	13·33	11·01	39·18	11·23	0·89	1·07
954	1749	44·43	5·66	32·70	17·21	13·35	2·25	1·41
1010	1850	47·30	1·45	48 20	3 02	13·03	2·12	1·65
1060	1940	48·84	1·25	46·31	3·68	20·77	2·78	1·88
1125	2057	50·73	0·60	48·34	0·303	23·95	0·48	2·11

A formula established by van t'Hoff affords the means of calculating the changes in the equilibrium-constant K, which accompany changes in the temperature of the reacting mixture. This formula is:

$$d\,l\,(K) = \frac{q}{2\,T^2} \times d\,T$$

in which T signifies the absolute temperature of the reacting mixture, and q the heat absorbed in the reaction. In the case in question, integration of the differential equation gives the formula—

$$l\,(K) = -\frac{5116}{T} - 0{\cdot}1947 \log. T - 0{\cdot}000505\,T + a\ Constant$$

The constant, on the assumption that the maximum value of K is 6·25 for 2825°, is −3·895. The results of the calculations by this formula are given in the ninth column of the table. Except at 674° C., at which temperature the action is very sluggish, it will be seen that the agreement between the experimental and theoretical values of K is fairly good, and is better the more favourable the conditions are for the observation. The discrepancies are about equally distributed either way.

It may be observed that only an apparent equilibrium subsists between the gaseous components of the mixture and the incandescent carbon. The ratio of the carbonic oxide to the carbonic acid changes, for instance, in a very extraordinary manner, and to a much greater extent than even the unusually high heat of vaporization of carbon would lead one to expect. More precise knowledge concerning this apparent equilibrium should be secured by further researches. An accurate solution of any one of these apparent equilibriums would be sufficient for calculating the composition of the generator gas for all temperatures of the generator. It would only then be necessary to bear in mind the connection which has been established once for all by the equilibrium discussed in this paper—viz.:

$$CO_2 + H_2 \rightleftharpoons CO + H_2O$$

BRITISH ASSOCIATION OF WATER-WORKS ENGINEERS.

We to-day conclude our report of the proceedings at the meeting of the above Association on the 10th inst. by giving the principal parts of the paper read by Mr. H. Bertram Nichols, Assoc.M.Inst.C.E., and of the discussion thereon. The subject of the paper was—

WATER SUPPLY FROM THE LOWER GREENSAND AT LEIGHTON BUZZARD.

The lower greensand is an important siliceous formation immediately underlying the gault, composed of soft yellowish sands with ferruginous seams, and it invariably contains a large proportion of solid impurity in solution, nearly all of a saline nature, which, although imparting some hardness, is not injurious to health. Both the upper and lower greensands are of porous and oxidizing strata, which rapidly destroy or remove the organic matter contained in the water percolating through them, and leaving mere traces behind. The proportion of organic elements in these waters is therefore almost invariably very small. Among their constituents they contain protoxide of iron, which probably exercises a reducing effect upon the nitrates and nitrites present in the water; thus removing their oxygen, and transferring a portion of their nitrogen into ammonia, while the remaining nitrogen escapes as gas. Even the sulphates present in the water are in some cases attacked, and sulphuretted hydrogen generated. The evidence of previous animal contamination is thus diminished or even obliterated altogether, while the water acquires a considerable proportion of ammonia.

The waters from the lower greensand are frequently slightly turbid owing to the friable character of the water-bearing stratum. They are palatable, and generally of a moderate degree of hardness. Occasionally they have a slight odour and flavour of sulphuretted hydrogen when first of all raised to the surface. These, however, soon disappear when the water is exposed to the atmosphere.

In connection with the water supply to the town of Leighton Buzzard, a well and boring has been sunk into the lower greensand. The well is 8 feet internal diameter, lined with cast-iron cylinders in segments carried down to a depth of 48 feet; and below this the well has been deepened a further 16 feet with 7 feet diameter cylinders. Beneath the well the bore pipes are carried down to a total depth of 200 feet from the surface; the tubes varying from 10 to 8 inches in diameter. A great deal of difficulty was met with during the construction of the works in consequence of the sand blowing below the depth of 48 feet from the surface. Down to this depth stiff gault clay was met with; but below this level sand, some of a very loose nature, with bands of varying thickness of grey sandstone, congealed stone, pebbles and sand, and some very hard stone. Owing to the difficulties experienced, the well sinking and boring operations from beginning to finish took about 2½ years to complete—many stoppages having occurred, and difficulties of an unforeseen nature having arisen.

The water above the depth of 175 feet from the surface is entirely shut out from the well, as upon analysis by Professor Attfield in November, 1892, although he reported the water as being most remarkably pure, and among the slightly hard or comparatively soft class of well waters, he mentioned its slight but temporary fault of containing, when first pumped, a little iron in solution. So it was decided to go to a lower depth, in the hope of finding the iron eliminated from the water. At the depth of 200 feet, the water was again tested by Professor Attfield, who reported, in July, 1893, that the water was of good quality for all drinking purposes. "The sample," he said, "contains a red ferruginous sediment. There was no trace of iron in solution. Poured off from the sediment—which is what everybody would do before drinking the water, and which is what I did before analyzing—the water is, as I have said, of good quality for all drinking purposes. I assume, however, that this ferruginous sediment was originally in solution; exposure to the air and the shaking in transit causing its deposition. If that be so, consideration must be given to the question of due exposure in reservoir or otherwise, and arrangements for the periodical removal of sediment if the water is to be used for supplying a town. Such depositing iron ensures purity in the drawn-off water." Upon this report, the author suggested that an aerating spiral trough should be fixed above the surface of the water in the circular tank in the tower, having level overflow-lips each side the channel across the centre of the tank, in order to ensure spray action; and this was incorporated in the scheme of water supply.

In consequence of the severe frost in the winter of 1894, the then Local Board decided to protect the outside of the tank with felt, on account of its extent of surface and exposed situation. But the result of this protection, which necessitated boarding over the top of the tank, was that the spiral trough arrangement did not answer so well as was previously anticipated under the former conditions.

After the works were completed at the end of 1896, and the water had been regularly supplied to the consumers for some time, sentimental objections arose with respect to the colour of the water, so Professor Attfield was again resorted to in October, 1897, when he reported in a similar manner as before on the sample submitted to him. He said: "It contains a perfectly harmless trace of iron, which soon settles. While settling, the water is unsightly; on the other hand, the iron affords a guarantee against organic impurity. I should prize such water as a town supply; but more especially if the iron could be deposited by exposure in reservoirs or otherwise before delivery to consumers."

Analytical Data.

One gallon contains the following number of grains and decimal parts of a grain of the respective substances:—

Total suspended solid matter, dried at 250° Fahr.	Traces
Total dissolved solid matter, " "	20 5
Ammoniacal matter, yielding 10 per cent. of nitrogen (equal to ammonia per million, 0·150.)	0·09
Albuminoid organic matter, yielding 10 per cent. of nitrogen (equal to ammonia per million, 0·070.)	0·04
Nitrites	None.
Nitrates, containing 17 per cent. of nitrogen (equal to grains of nitrogen per gallon, 0·04.)	0·22
Chlorides, containing 60 per cent. of chlorine (equal to grains of chlorine per gallon, 1·15.)	1·9
Hardness, chalk-grains or degrees: Removed by ebullition, 11; unaffected by ebullition, 3—total	14·0
Lead or copper	None.
Physical examination, a faint brownish tinge (iron).	
Oxygen absorbed in three hours (by iron)	0 16

The discoloration of the water remaining a source of trouble to the District Council, they consulted Mr. Holme, the Manager of the water-works at Hornsea, near Hull, at which place the water was stated to be of a similar nature, and had been satisfactorily treated at his hands. He reported that the water when pumped from the well was clear and bright; but when delivered from the rising-main emitted a sulphurous smell, and that this arose from the gas dissolving the oxide in the water, which, when exposed to the air, deposited in the pipes and domestic utensils. He recommended a method of precipitation by breaking the water up and exposing it to the atmosphere; passing it next through filters of coarse gravel and sand, which should retain the oxide; and then storing it in a reservoir sufficient to hold about a day's supply.

From the report of a deputation which visited Hornsea accom-

panied by Mr. T. Hughes, the Water Manager, they found there was a great difference between the water at Hornsea and that at Leighton. At Hornsea the water practically remained clear the whole time; and there seemed to be no difference in the colour of it after exposure. At the same time, there was a deposit of iron after standing only a short time; and this deposit was easily retained by the filters. It was considered, however, better to allow the Leighton water to stand in settling-tanks and deposit before passing through the filters, as the Hornsea process would not take out the iron by working continuously. The deputation recommended that the Council provide an aerator, settling-tanks of sufficient capacity to allow ample time for depositing, afterwards passing the water through a sand filter into a reservoir to give a sufficient body of water for the pumps to draw on.

Mr. Hughes's opinion on the subject is that exposing the water to the atmosphere does not remove the iron, but that it is necessary that it should be exposed before it can be removed. When the water is pumped up from the well, it is perfectly clear before its exposure to the atmosphere. But after being exposed, it becomes very much discoloured; and this gives cause for numerous complaints. Mr. Hughes has fixed up an apparatus at the tower for the purpose of ascertaining whether aeration and filtration would remove the iron; and the experiment has proved successful. But in consequence of his leaving the town to take up a more lucrative appointment, the experiments have been suspended. The water was first passed through an aerator, which consisted of a pipe carried up a height of about 25 feet, and on this pipe were fixed three perforated discs, placed one above the other and about 18 inches apart. The water falling through these discs in the shape of rain allowed the air to be thoroughly mixed with the water, which was afterwards conveyed into a tank through a trough, which again acted as an aerator. In this tank the water became much discoloured, owing to oxidation taking place as a result of the aeration. After this treatment, the water was passed through a gravel and sand filter, when it became perfectly clear and bright, and did not show the least sign of discoloration after being exposed to the air for fourteen days. Mr. Hughes, from continued observation, considers it necessary that the water should remain some time in the settling-tank, otherwise it would oxidize in the filter, with the result that the iron would be found near the invert of the filter, necessitating great expense in cleaning out. It would be better if it were allowed to stand 24 hours after aeration. The iron would be found at the top of the filter, and could readily be removed; and the water would then be freer from impurities.

The Council are about to adopt a scheme on the above method to remove the discoloration of the water; and this will probably form one of the first measures to be taken in hand by their new Manager. The water from the well is raised into the wrought-iron tank, 30 feet in diameter and 19 ft. 3 in. in depth, carried on the walls at a height of 62 feet above the ground-level. The tank is divided into two parts for a depth of 5 feet from the bottom of the tank. This division was made in order to allow the whole of one side of the tank to be cleaned out, while there would remain on the other side of the division a sufficient supply of water for the ordinary purposes of the town. The capacity of the tank is 80,350 gallons; the depth of water with this quantity being 18 ft. 3 in. The arrangement of the engines and pumps is in duplicate. Two Crossley 9-horse power nominal gas-engines work the two sets of three-throw pumps; and on the same floor are two other gas-engines, with air-compressors for working the ejectors in connection with the town's sewerage scheme.

In connection with the discoloration of the water, the "Fischer" system of water filtration is being considered by the Council; and Mr. Hughes has submitted proposals by which he estimates the required desiccation of the iron from the water could be arrived at by an expenditure of about £800. For the water supply of small towns situated on the lower greensand, and where they are dependent upon a supply from this stratum, it becomes a serious matter to abstract the iron from the water, necessitating, as it appears to do, additional machinery and pumping the water to an elevated tank after it has been raised from the well or borehole into the settling-tanks or other apparatus requisite for its treatment. Where the water passes over or through the chalk or other calcareous stratum, the hardness is sometimes excessive, as at the Barton boring, near Cambridge, where the total hardness reached 44·3°. Generally speaking, however, the waters from the lower greensand are good and wholesome for drinking and cooking purposes; but in many instances they are too hard for washing.

Discussion.

Mr. W. G. Peirce (Richmond) inquired the cost of the well and boring, and also whether the work was done by contract or administration. He noticed that the pumping was done by gas-engines; and he would like to know the cost per 1000 gallons of water raised, and the quantity obtained from the well per day.

Mr. W. Coles Finch (Chatham), having mentioned that he expected soon to be engaged on a boring 600 feet deep, asked to what height the water rose in the borehole described in the paper, the delivery in gallons per hour, the diameter of the perforated tube, and whether in the author's opinion it would not be possible for water engineers to do their own boring, provided they had men used to such work. He thought he should carry out the boring he had mentioned himself. There was an enormous profit on well boring—in fact, he had good reason for believing that 75 per cent. of the price paid was profit. He did not see why, with care, they should not be able to do such work themselves. Tools could be bought or hired at a reasonable rate.

Mr. F. J. Bancroft (Hull) inquired whether tests of the yield were made when the well was sunk and then subsequently, to ascertain whether the yield had been maintained. As they all knew, in working in the lower greensand a difficulty was often found to result through the sand running in, and thus partially choking the tubes. The water at Leighton Buzzard appeared to him to be one that could be treated both chemically and mechanically; and the trouble which they had had to deal with seemed to have arisen through the work not having been tackled in the first place on a scientific basis. The sample that was sent to the analyst was, in his opinion, improperly taken. It was allowed to be aerated; and the iron had deposited in the sample when delivered to the analyst. The sample ought to have been taken under water, so as to have been kept free from the oxidizing effect of the atmosphere. In his opinion, a water of this description wanted to be dealt with in two ways: First, it should be aerated—exposed to the atmosphere—which would cause the iron to deposit; and then it should be mechanically separated from the water. He noticed that the tank was boarded over the top; so that the arrangement described for aerating the water was rendered useless. Aeration was provided first; then means were taken to prevent it. Consequently aeration did not take place in the tank, but in the consumers' cisterns and domestic vessels. He was present at the opening of the new water-works at Hornsea a short time since. There the water first passed through an aerator, then over three circulating tumbling discs, was then filtered, and stored in the reservoir. Sand filters were used; but previously cloth ones were employed. He could not agree that at Hornsea, the water remained practically clear the whole time. That seemed contradictory to what they would expect. If the oxide of iron was deposited, the water could not possibly remain clear the whole time. It was considered advisable to allow the Leighton Buzzard water to stand in settling-tanks. He presumed this was after aeration; but it seemed to him there would be little use in allowing the water to be exposed in such a manner with only the surface in contact with the atmosphere. The proper way was to expose an enormous amount by spraying. He should also like to know the value of the wrought-iron tank to which the water was raised from the well. If he understood correctly, this was previous to the aeration and settlement. It seemed to him that the raising of the water to this tank was useless; and the money spent on it had better have been devoted to additional aerating power. The water after analysis should show exactly the treatment it required; and it only wanted to be treated in this way to ensure success.

Mr. W. W. Gray (Cambridge), referring to the statement in the paper that the water from the Barton boring, near Cambridge, reached a total hardness of 44·3°, suggested that there must be some mistake. From his experience of borings in the neighbourhood of Cambridge, he could assert that the hardness of the water from the lower greensand did not exceed 4° or 4½°. The 44° absolutely varied from all analyses he had had made. He had a boring in the greensand at a depth of 202 feet; and the hardness of the water was 4½°. They had had no difficulty whatever with oxide of iron. The only difficulty they expected was in the mixing of the lower greensand and chalk waters; but fortunately there had not been any trouble in that respect.

Mr. E. J. Silcock (Leeds), having pointed out the omission of information as to cost, population, quantity of water obtained, &c., agreed with a previous speaker that where engineers could give the work their personal attention, or had competent assistants who could give constant attention to it, a boring should be carried out by administration. He had had some little experience of boring both by administration and contract; and the prices asked for boring were, as a rule, very excessive. In doing the work by administration, he advised that the plant should be purchased, as the cost of hiring it was as bad as paying for the work being done outright. The tools were not expensive; and after the work was finished, they could be sold. It did not always follow that water from the lower greensand contained iron. He had himself put down a borehole into the lower greensand; and the water had not the slightest trace of iron in it. He noticed that Mr. Nichols had air-compressors on the premises for working the ejectors in connection with the town's sewerage scheme; and he thought it would be a cheap and easy matter to arrange to apply this air for aerating the water. He also requested information as to how the bore-tubes were put down, and what precautions were taken to exclude the sand.

Mr. T. W. A. Hayward (Sudbury), alluding to the use of gas-engines for pumping, said it would be interesting to know the price of the gas, as it varied considerably in different towns. In one town he had been in only 2s. 3d. per 1000 cubic feet was charged; while now he had to pay 4s. 5d. So that while gas-engines might pay in one place they would not in another. Reference had been made to the profits of contractors for borings. They were not always large. He knew of an instance in which a contract was let for boring a well 50 feet, commencing 150 feet from the surface; and the contractor only asked 12s. 6d. per foot. After the men got down about 20 feet, one of the tools broke. Then they had to wait two or three days before they could get the necessary appliances from London to get the tool up. When the machinery was started, it also broke down—

in fact, accident after accident happened, until four men were four weeks before they could make a fresh beginning. Supposing each man was only paid £1 a week, it would be seen that this one accident cost £16; whereas the value of the whole job (which took about ten weeks) was only £31 5s.

Mr. W. Whitaker (Croydon) pointed out that in papers of this description—of a more or less local character—there was the danger, into which authors fell quite naturally, of only thinking of the district of which they were writing, and not of others. They made statements that were perfectly true with regard to one district; but they forgot to qualify them with respect to others. He referred particularly to the first few sentences in the paper. He could not quite understand why the analysis of Professor Attfield should have led to the abandoning of the water in the upper part of the sand. The reason given was because of the iron it contained. But there was iron in the water taken lower down; and he could not see that there would be any more difficulty in dealing with the iron in the water from the upper than from the lower part. Constantly the opinion was expressed that people had only to sink into the lower greensand to get all they wanted. Papers of this kind showed that there were difficulties in these sand supplies. They were not so very easy to get; and the water was not much better than other waters. It was certainly no better than limestone waters. Then there was the question of fine sand running over into the borehole; and, of course, if they attempted to pump from a borehole in the sand, they would certainly have the borehole stopped at some time or other. Coming to Professor Attfield's analysis, he said it had the usual fault—there was not enough of it. They were told the total of the suspended and dissolved solid matter; but they were not told what that solid matter was. They were only informed that it was not lead or copper, and that they knew before. He should like to know the percentage of iron in the water. He thought the Hornsea water was a chalk one, and did not come from the lower greensand. If this was so, there would, of course, be a considerable difference. The author also stated that where the water passed over or through the chalk, the hardness was sometimes excessive. He (Mr. Whitaker) did not know whether that alluded to some underground infiltration of chalk water into the lower greensand, or whether it merely referred to chalk water. As regarded the hardness of this particular water, he did not quite understand it. They were told that 11° of hardness were removed by ebullition—that was to say, the hardness of the limestone water, which was comparatively not hard. It was not the hardness they would expect from the lower greensand water. He suggested that Barton near Cambridge should read Barton in Bedfordshire. The 44° of hardness in that case was enormous; and there must be some special reason for it. If it was the place he was thinking of, the springs were from the base of the chalk, or very near it—either at the top or lower down in the chalk marls. However, it was very interesting to get hardness of that sort recorded. The question was coming to the front as to whether the charges for boring were not very high; and in some cases they certainly were. In America where the cost of labour was heavy, they could do boring cheaper than in this country. There must be some reason for this. The case mentioned by Mr. Hayward was rather unfair. They ought to take the average cost of several works, and not one where a series of accidents happened.

Mr. C. Sainty (Eton) remarked that the author stated that the water above the depth of 175 feet from the surface was entirely shut out from the well; and yet it appeared that he had a length of perforated tubes to within a short distance (about 34 feet) from the bottom. He should like to know how the water was kept out of those perforations. It was rather strange to have a perforated pipe with blowing greensand, as it seemed to him that sand must get into the perforations.

Mr. C. E. Jones (Leyton) said, in his estimation, the value of the paper would have been increased if the analysis of the water had been complete. It would have been more scientific, and certainly more satisfactory, if the water as brought from the greensand had been analyzed, and had it been followed in its various stages—showing the reactions that took place in the water from time to time, and the means adopted to bring about the reactions. The iron, he took it, could be precipitated by aeration. Pure oxygen would be better; but that would be expensive, and so they had to use atmospheric oxygen. If he had had to do this work, he should certainly have aerated the water by compressed air as it was being pumped into the cistern. Atmospherical aeration was slow, and time and space were required to carry it out; whereas if the water was charged with air under pressure, the same result could be obtained in less time, and more satisfactorily. He should like the author to tell them where the sulphuretted hydrogen came from. This was a poisonous gas, and had a most abominable smell. He did not see any mention of pyrites or sulphur which might account for the formation of the sulphuretted hydrogen. He mentioned other points on which information should be given. He also had an idea (which might be right or wrong) that, if the hardness of the water were materially reduced, there would be less trouble in dealing with the iron chemically. It would also be interesting to know whether milk of lime had been tried in treating the water for its inherent complaints. A little iron was not always objectionable. People now liked white water; and iron in the state of protoxide of iron discoloured it. In some parts of the country, brown waters, such as came from the peat, were habitually used; and people got to like them in preference to white waters. The colour was not always a criterion of its quality.

Mr. J. S. Pickering (Nuneaton), who had to deal with a somewhat similar water in North-East Warwickshire, said that, in seeking for a larger supply, it had been necessary to sink deeper; and they had come across water impregnated with iron. They had found it some 20 miles along the same strata. He believed the method adopted at Leighton Buzzard for removing the iron was the proper one, although it was exceedingly expensive for a small town; but he did not see any other way out of the difficulty. They could not supply the water without removing the iron. The sentimental objection was a serious one. In his opinion, the course to adopt was first to aerate the water, allow it to settle in a sedimentation tank, pass it on to sand filters, and then discharge it into the service reservoir. He had adopted the floating arm arrangement, so that the water could be decanted from the surface instead of from the bottom, because any iron that did not deposit in the filters would have an opportunity of doing so in the reservoirs. In his case, the water on being pumped was clear in appearance; but after 24 hours or so it became turbid, and after 48 hours the deposit of iron took place.

Mr. S. E. Norman (Burgess Hill) described his method of treating lower greensand water. They pumped it up, and allowed it to fall over a serrated trumpet mouth on to a bed of gas coke. The serrations were so arranged that the water spun in ringlets, and took in air. The gas coke was rough, and so scrubbed the water. It was then run into a channel round the sides and end of a large filter-bed; and in that channel were placed lumps of coke, so as to imitate a stream running in the natural way over boulders. Then the water passed over an apron of coke on to the filter-beds. He found this system most successful, and had not had the slightest complaint since they adopted it. They treated from 8000 to 10,000 gallons per hour over 2000 square feet of filter-bed.

Mr. J. Shaw (Boston) believed that every water required special treatment. There were scarcely two waters alike; and there were very few waters from the lower greensand that were exactly similar. The analysis struck him as being peculiar. The hardness of the water was very high; from 4° to 9° being the average hardness for lower greensand water. Where the hardness rose above that, there were suspicions of surface pollution. He believed that occasionally where these borings passed through chalk, the water was not from the lower greensand at all—the water ran from the chalk into the lower greensand. One thing that struck him as curious was the amount of albuminoid organic matter, 0·04. At Boston, about two months since, in water that had been in store some time, the albuminoid matter was 0·2; and the analyst said it was unfit for consumption. Mr. Silcock had suggested the forcing of air into the rising-main. With some waters it would answer; but in one case in which he recommended it, the water contained a large quantity of iron in solution, and a great deal of rust was deposited in the main. In seven or eight months' time, there was considerable back pressure on the pump; and another pipe had to be laid, as the other was practically choked up.

Mr. W. Watts (Sheffield) said the idea had struck him that, in clarifying this water, it would be a good thing to have a greater bulk of it, in order to give it a much longer exposure to atmospheric agencies. It was a fact that exposure did not deteriorate water; it made it better—bleached it in fact. From his experience, corporations could carry out borings much cheaper than contractors. With reference to water being raised to a height, and dropped down again, it seemed to him that a good deal of it in windy weather would be lost in spray.

Mr. H. Ashton Hill (South Staffordshire Water Company) thought that water engineers should well consider the question before they themselves embarked on well sinking and boring operations. There might be circumstances where engineers were favourably situated, with time on their hands, and could go into this department; but even then he should hesitate. Speaking from his own knowledge of two or three boring companies, he said they considered themselves well off if they obtained a dividend of 10 per cent.; and he did not think they should be begrudged this return, on account of the risky character of the work. A contractor might get a good job, and make a little money out of it, which would perhaps pay for losses on the next. For such work as this, he advocated the employment of the highest class of contractor. He had lately had to revise his views on the matter. He had only just completed one boring, and was engaged on another. He was also getting out designs for two large ones—33 inches diameter for 300 feet, and below that a further 300 feet of 18 inches diameter.

Mr. J. Johnstone (Brighton) asked whether the author tried the yield of this borehole in 1896 and again this year; and, if so, what was the difference. Probably he would not find a difference yet from the lower greensand, although at Leighton Buzzard it was not very deep from the surface. In his (the speaker's) own case, there had been an enormous falling off in the underground water, due undoubtedly to the want of rain last autumn and winter. His own feeling was that it would not affect the lower greensand yet, even if it did at all. He had had some difficulty with oxide of iron in connection with two water supplies with which he was connected; and they got over the difficulty quite easily by aerating the water directly from the pumps, pumping over a trumpet mouth, letting the water fall into a

reservoir and settle there, from thence flowing on to the filters, and then pumping into the district. In one case the filter was on the top of the reservoir itself. The water supply simply filtered through the sand, down a small channel, and into the reservoir below.

Mr. W. G. PEIRCE (Richmond) remarked that, for the benefit of the engineer in charge, it was preferable that work should be placed in the hands of a contractor; but there came a time when it was utterly impossible to let the work having regard to price. He was engaged in driving adits, 6 ft. 4 in. in height and 4 ft. 6 in. in width, 300 feet below the surface of the ground. The contractor's price was £3 per foot for the first 50 feet, and £4 beyond. This was such an excessive charge that the Corporation had purchased the plant for £1200, and had now nearly completed 2 miles of adits at a cost of 30s. per foot.

Mr. C. H. PRIESTLEY (Cardiff) said Mr. Hill had remarked that in one place a boring contractor might make a lot of money, and in another might lose on the work. Where he made a great profit, he did so at the expense of the town; and the town lost money which would have been saved if the work had been done by administration. In the other case, it was obvious the town would not be paying an adequate amount for the work done. It was hardly fair to make one town pay for another.

The PRESIDENT spoke of the enormous time taken to sink the well. Taking 300 working days in a year, he found that no less than three days were occupied per foot. He entirely failed to understand the analysis, coming from such an analyst as Professor Attfield. It was stated that there were merely "traces" of total suspended solid matter. This appeared to answer the question as to whether sand was brought up in the borehole. In this sample, it was not; but, on the other hand, the sample might have been taken from an overflowing boretube. The next point was the ammonia 0·09, and the albuminoid 0·04. Many medical officers of health would pull long faces if they had to deal with results like that. He (the President) felt convinced the amount was too high; and that there must be some reason for it. The whole thing was perplexing, because when they came to the hardness, they found the total was 14°, which did not point in any degree to a regular recognized lower greensand water pure and simple. He thought there must be an intercommunication between the chalk and the greensand series. With regard to dealing with this water, it appeared to him to be a simple case; for here occurred in the natural condition of the water that which, in the Anderson process of purifying water, was brought about by artificial means. In that process iron was used for the purpose of getting rid of the organic matter, and then the water was left charged with iron, which was easily dealt with by filtration. He could not understand why in these days the tank was constructed of wrought iron, instead of steel. He also protested against the use of the word "nominal" in connection with the power of engines, and begged members in future to give the brake horse power.

Mr. NICHOLS, in reply, said he had not brought with him many details, as he did not expect such a discussion; but he would answer the questions so far as his memory would permit. The population of Leighton Buzzard at the present time was about 7000. It was not anticipated that it would increase very rapidly; and provision was made, in the first instance, for about 9000 people. It was a combined scheme of water-works and sewerage; and the total cost of it was £22,500. The cost of the water supply distinct from the sewerage scheme was about £9000; and that of the well and boring, about £1350. As to the perforated tubes and the shutting off of the water to a depth of 170 feet, he explained that, when they reached that depth, they tested the water, and found a larger quantity than was at present raised—he believed about 15,000 gallons an hour—but, there being iron in it, they wished to obliterate it. The perforated tubes were not removed; but a lining was put down in between, which shut off the water from the perforations. Then they went down to a depth of 200 feet; and the quantity of water now raised was 12,000 gallons per hour. Since the works were completed, the water had risen in the well 4 or 5 feet; and he did not think it had ever gone lower than it originally stood. The height at which the water stood from the surface was practically 47 ft. 6 in.; and for the purposes of pumping, a depth of 17 ft. 6 in. stood in the well, so that they did not pump from the borehole. The real point in the paper was the removal of the iron in the water. Treating it with coke filters and so on seemed very reasonable where the water could be raised to a high ground, and then passed through a trough into a filter; but unfortunately there was no hilly site within a reasonable distance of Leighton Buzzard. There had been three different analyses by Professor Attfield; and he had chosen the most recent. The analyses slightly varied; and he was sorry he had not included full details of them. The sediment in the water was about 2 grains per gallon. The well and boring were carried out by Messrs. Isler and Co.; and the length of time taken to complete the work was owing to its stoppage by the old Local Board—on one occasion for six or seven months. When they first began to pump, they did find a great deal of sand in the water; but at a lower depth, there was not so much. At the present time, very little sand was coming out of the borehole; it was the red ferruginous deposit that was the trouble. The information as to the Barton well was taken from the sixth report of the Rivers Pollution Commissioners. Milk of lime had not been tried in connection with the Leighton Buzzard water.

REGISTER OF PATENTS.

Mantles for Lighting by Incandescence.—Plaissetty, A. M., of Paris. No. 26,381; Nov. 12, 1897.

This invention has for its object "to produce mantles possessing a degree of tenacity, flexibility, and durability both of structure and of illuminating capacity unattainable by the method of impregnation." It consists essentially in the preparation of a collodion formed by the solution of trinitro-cellulose in glacial acetic acid, and capable of holding in solution or emulsion any incandescent salts or compounds, the production therefrom of filaments by extrusion through capillary dies, the doubling together of such filaments to form loosely twisted threads, and the denitrification of the filaments or threads.

The method of operation is as follows: Nitro-cellulose is dissolved in glacial acetic acid, in proportions which depend on the degree of viscosity required, which may vary according as the collodion when formed into filaments by extrusion is to be passed through a coagulating bath, or as the pressure available is sufficient to thus "spin" a collodion which is so viscous that coagulation will be produced by the mere passage through the air, without the use of any bath. The patentee takes (say) 1200 grammes of glacial acetic acid, 100 grammes of gun-cotton, and from 30 to 50 grammes of incandescent salts, according to their quality and illuminating power. He first makes a sirupy or concentrated solution of the incandescent salts in the form of nitrates, in a small quantity of glacial acetic acid. He then dissolves 35 grammes of the gun-cotton in 500 grammes of the glacial acetic acid, and adds slowly the sirupy solution of the salts thereto—stirring meanwhile, so as to produce a homogeneous mixture. He then dissolves the balance of the gun-cotton in the remainder of the glacial acetic acid; and these two solutions are mixed by adding small quantities of the former to the mass of the latter.

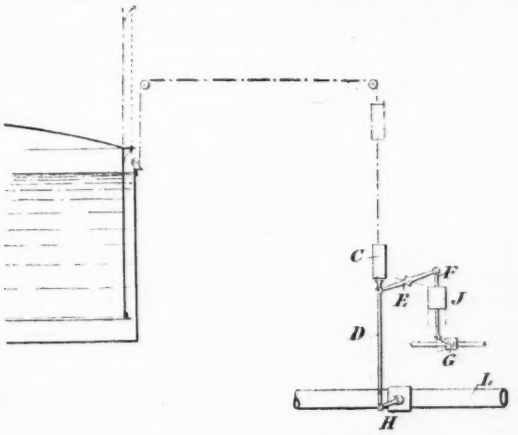
The salts preferred are the nitrates of thorium and cerium in the proportions of: Thorium, 99·25 per cent.; cerium, 0·75 per cent. But mixtures may be used of zirconium and lanthanum, in the proportion of about 60 per cent. of zirconium and 40 per cent. of lanthanum, with ½ per cent. of cerium; and similarly for other salts obtained from the treatment of monazite sands.

Having obtained an intimately mixed and viscous mass, it is subjected to two consecutive filtrations—first through a coarsely-meshed, and afterwards through a finely-meshed fabric. The viscous or semi-fluid product thus obtained is then "squirted" or "spun" into the form of fine filaments by extrusion, under a pressure of 70 to 150 lbs. per square inch, through dies formed of glass tubes of capillary bore; the hair-like filaments so formed being received in a bath of ammoniacal alum to remove the excess of acetic acid. The filaments are then wound spirally on a revolving drum mounted on a sliding carriage receiving traversing motion by worm gear, and may at once be denitrified (as hereafter described), or may first be dried and wound on to bobbins which are then placed in a doubling machine to form a thread, the degree of torsion being varied according to the purpose for which the mantle is to be used. Thus four or more filaments form a thread to be used for mantles to be employed with the ordinary bunsen burner, and eight or more in the case of high-pressure lamps. A great surface of contact with the flame, and consequently a great light-emitting surface, is thus obtained; and "as the filaments, though lightly twisted together, are still separate and distinct, their aggregate incandescence is greater than would be that of a single filament of the same size as the combined filamentary thread."

The denitrification is effected by immersion in a bath of 20 to 25 per cent. of sulphydrate of calcium (calcium hydrosulphide), heated to a temperature of 40° C.; the use of calcium hydrosulphide for this purpose forming the subject of another patent, No. 3770 of 1898. In an hour or two, the thread is completely denitrified, and the salts are precipitated in the filaments in the form of oxides. The thread is then air-dried, and the mantle is formed by knitting in the ordinary way, after which it is subjected to the action of a blow-pipe flame, as usual.

Gas-Exhauster Regulator.—Cutler, S., of Millwall, E. No. 26,791; Nov. 16, 1897.

The object of this invention is to automatically regulate gas-exhausters by causing the holder which they are exhausting, when it has reached any predetermined minimum height, to reduce the speed of the exhausters and operate a bye-pass valve to return gas from the outlet to the inlet of the exhausters, so as to permit them to run at a reduced speed without decreasing the arranged minimum height of the holder.

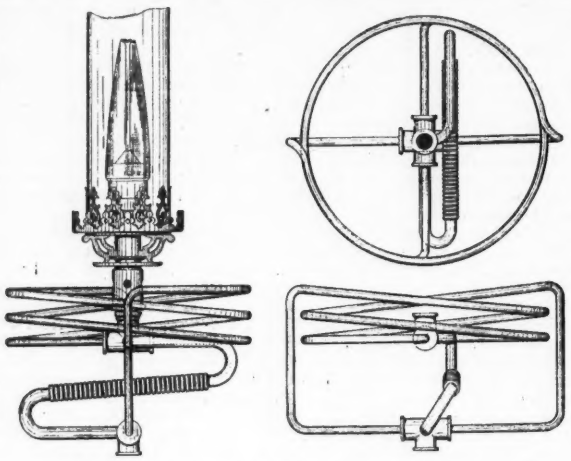


One method of carrying out the invention is to connect the holder by wires, chains, or equivalent parts to a weight C guided to rise and fall vertically, and placed adjacent to the exhausters. This weight, when it reaches any predetermined position, operates a series of links or other

mechanical parts D E F, which in turn actuate the throttle-valve G, placed in the steam-supply pipe of the engine, and a throttle-valve H placed in a pipe connecting the inlet and outlet of the exhauster. In this way, instead of further exhausting the holder, the gas simply passes through the exhauster and back from the outlet to the inlet through the bye-pass pipe L; the speed of the exhauster engine being reduced at the same time by throttling the steam supply. When the volume of gas within the holder again increases, the weight C is raised, and the counterpoise weight J reverses the lever and throttle-valves to their previous positions.

Anti-Vibratory Supports for Incandescent Burners.—Eldridge, J., of Oxford. No. 30,560; Dec. 28, 1897.

In order to afford a steady support for incandescent gas-burners, the patentee proposes to employ two tees or other suitable fittings, one of which is adapted to be connected to the gas-supply pipe or other convenient part, while the other supports the burner. The two fittings are



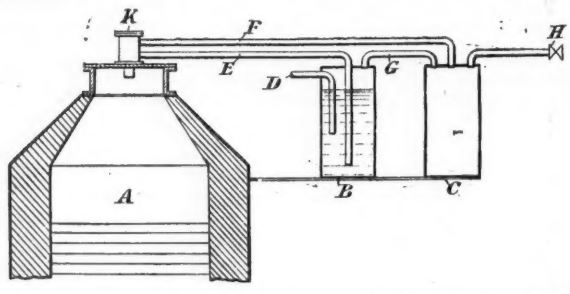
connected by two springs coiled together, as shown in the engraving, so that the burner-fitting is supported by them on two opposite sides. The burner-fitting is connected to the other fitting or to the gas-supply pipe by a flexible tube.

Burners for Acetylene or Rich Oil Gas.—M'Conechy, J., of Glasgow. No. 28; Jan. 7, 1898.

In order to obviate the carbonization of the heat-resisting material of which the top of burners used for acetylene and other rich gases must be composed, the patentee proposes to take off their sharp corners or edges, and so impart to the top of the burner a flat, even surface, or a surface approaching to convexity. In this way, he removes the area of combustion of the flame to a slightly higher altitude. The arc of the flame, and the arc or flat surface of the burner, unite at a central point of their apexes, in order to preserve the burners and enhance their duration.

Oil-Injector for Water-Gas Carburetters.—Botley, C. F., of Hastings, and Cutler, jun., S., of Millwall, E. No. 692; Jan. 10, 1898.

This invention relates to the combination of an atomizer for oil—preferably of the kind described in patent No. 9316 of 1896—communicating with the carburetter, an oil-reservoir in communication with the atomizer, and into which the oil is conveyed and subjected to pressure, and a pressure chamber in communication with the oil-reservoir and also with the atomizer.

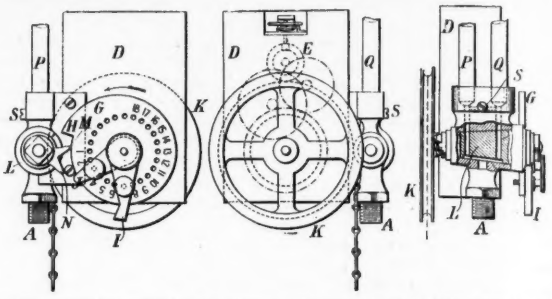


In the arrangement shown, the oil, preferably preheated, is conducted through a pipe D into a reservoir B, wherein it is subjected to a considerable pressure of steam, air, or other gas supplied from the chamber C through the pipe G. The pressure in the chamber C is regulated by a controlling valve H in the supply-pipe. The oil under pressure in B is forced through E to the atomizer K, and, encountering there a jet of steam, air, or other gas coming from the chamber C through F, is broken up, and enters the carburetter A in the form of a finely-divided spray.

Extinguishing Gas-Lamps at a Predetermined Time.—Gunning, J., of Bournemouth. No. 1539; Jan. 19, 1898.

This is a modification of patent No. 7011 of 1897; and, in his present specification, by way of example, the patentee supposes that there are a number of gas-lights, one or more of which have to be extinguished or lowered some time before the others. To effect this, he provides a stopcock which governs two passages from the service-pipe—the one passage being so arranged as to be closed or partly closed when the plug of the stopcock is in one position (the other passage being then open or partly closed), and both passages being closed when the plug is turned to another position.

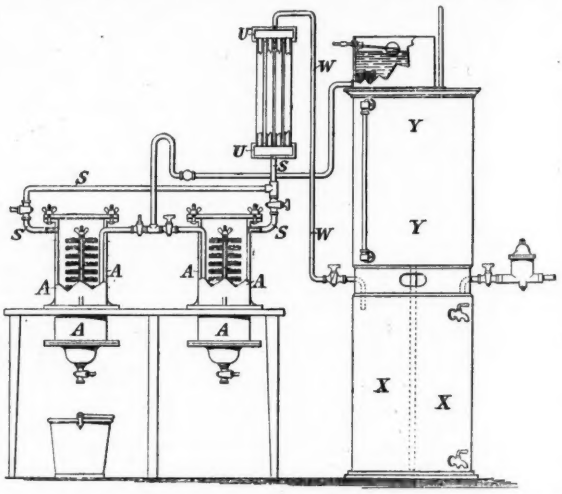
The illustration shows front and back views, and a section through the stopcock. As in the former patent, K is a chain-wheel fixed on the axis of the clockwork spring, which is wound up by pulling the chain; and G is the disc also fixed on the axis of the spring. A is the gas-supply pipe, in which is fitted a two-way cock L, on the plug of which is fixed a lever having two arms M and N; and free to turn on the axis of the disc G, are two arms I and J, of which I is the longer. These arms can be set on the disc G in positions corresponding to any of the hours marked thereon, and held by setting screws. In the plug of the cock L, there is a longitudinal passage communicating with two transverse passages corresponding to ports leading to two gas-pipes P and Q, each supplying a burner or set of burners.



The apparatus operates as follows: The arms I and J being fixed in the desired position on the disc G (say, I at 7 and J at 3), when it is desired to light the gas, the chain is used to turn the disc G in the direction of the arrow, so that its shoulder H, acting on the arm M, turns the plug of the cock so as to put both pipes P and Q in communication with the service-pipe A—both sets of burners being thus supplied. The spring having been wound by the pull of the chain, the clockwork goes on moving the disc G back until the shorter arm J, meeting the arm M after three hours, turns the cock partly round, closing the passage to P, and so extinguishing the one set of lights, but still leaving the passage to Q, for the other set of lights, sufficiently open to keep them full on, or, if desired, less open so as to lower them, according as the passage is made more or less wide. As the clock continues to go, the arm I, after seven hours, acts on the arm N, and turns the plug so far as to extinguish the set of lights supplied by Q. When it is desired to lower at the earlier hour and extinguish at the later hour either one light or a single set of lights, a plug is inserted at Q, so that when the arm J shuts off the supply to P a supply passes to P through the other passage, which can be regulated by the screw S; then at the later hour the arm I extinguishes this by closing the supply.

Generating and Storing Acetylene.—Slott, J., of Oldham. No. 8439; April 9, 1898.

In this apparatus, the calcium carbide holders consist of cylinders A, coupled up by water-supply pipes, each having a tap so that either can be shut off at will. The pipes lead downward to near the bottom of the cylinders respectively, so that the water has a rising flow therein to saturate the carbide gradually and proportionate to the supply. Each



cylinder has a rod fitted with a series of superposed trays kept apart by short lengths of tubing, and the whole rigidly fixed by a top nut, so that they can be removed, and separately charged with carbide. The gas gradually generated by contact of the water with the carbide passes by the pipes S to a condenser, consisting of top and bottom boxes U, connected by pipes. The condenser is exposed to the atmosphere, and so tends to cool the gas and deprive it of any moisture it may carry up before it enters the pipe W, which leads the gas into the upper part of the holder X. As the pressure and volume of gas increases, the water from the holder is driven back, and rises in the tank Y; and so one equilibrates the other proportionately to the consumption.

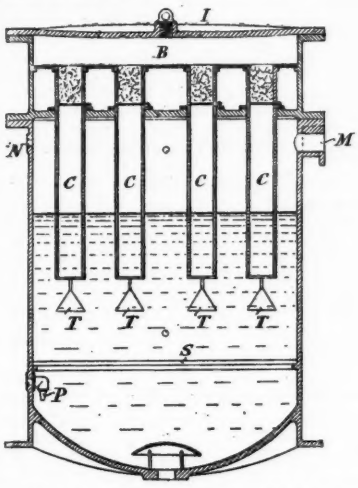
Prepayment Apparatus for Meters.—Mayer, C. P., of New Haven, Conn., U.S.A. No. 12,588; June 4, 1898.

The patentee proposes the combination with a controlling shaft carrying a notched disc and an operating shaft carrying a coin-receiver, of a

single connecting lever carried by the coin-receiver, and adapted to be tilted by the insertion of a coin—one end of the lever being formed to directly engage the notched disc thereby connecting the shafts. The controlling shaft (carrying a notched disc, an operating shaft, and a fixed barrel in which the inner ends of the shafts are journalled, and which is provided with a vertical slot) is combined with: (1) A coin-receiver carried by the operating shaft, and oscillating upon the barrel; (2) a connecting lever carried by the coin-receiver, which is tilted by the insertion of a coin, and caused to engage the notched disc; and (3) a spring acting on the connecting lever to normally retain the lever out of engagement with the notched disc, and after a coin has been inserted to expel the coin through the slot in the barrel, when the coin-receiver registers with the slot. The details of the invention are not intelligible apart from the four sheets of drawings accompanying a lengthy specification—9 pages of print and 42 distinct claims.

Acetylene Generator.—Rosenthal, K. E., of Berlin. No. 14,049; June 24, 1898.

This invention relates to an acetylene gas-generator composed of a number of carbide receptacles put into action in the usual manner by the sinking of a gasholder; and it has for its object "to provide improved means for controlling the supply of carbide to the water receptacle, and thus the generation of the gas."

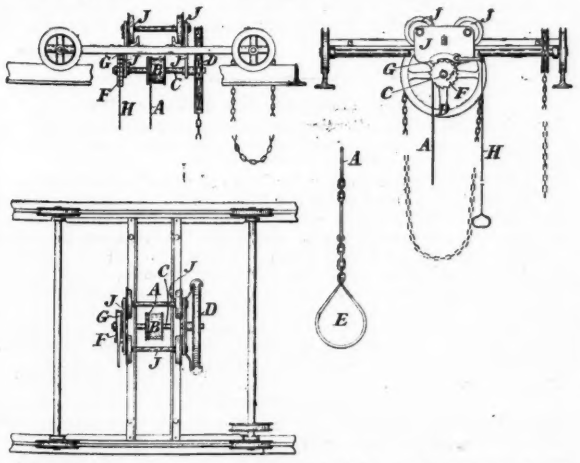


The generator consists of a chamber, above which is an impermeably closed carbide receptacle B. C are pipes partially immersed in water (but separated from the water chamber by means of slides); the upper portions of the pipes serving as receptacles for the carbide. Below the pipes are distributing cones T for the carbide, which falls on to the bars S. At the side is a water-supply pipe with an injection nozzle P. N serves for the screwing on of a manometer and a safety-valve; while M is the pipe leading to the gas conduit. At the bottom is a sieve with an aperture for carrying off the water and the sediment.

The action of the generator is as follows: The cover I is opened, and the carbide poured into the pipes E, the lower parts of which are shut off by the slides already referred to. Thereupon water is admitted at P. Then, by turning a spindle at the side of the generator, the slide is shifted; and the carbide, in consequence of the gradual movement of the female screw on the spindle, falls by degrees (not suddenly) over the distributing cone T into the water and on to the bars S. The pressure of the generated gas at once raises the gasholder bell. If the pressure of gas be relaxed, then, upon the sinking of the bell, the stops strike against the levers, one after the other, according to the extent to which it is desired that gas should be generated.

Charging Gas-Retorts.—Ingram, S. J., of Truro. No. 14,438; June 30, 1898.

This is a combination of chain-wheel, drum, and ratchet and pawl, with a carrier and scoop, for the purpose of charging gas-retorts.



A is a wire rope, to the free end of which is attached the carrier E; the other end being fixed to the drum B keyed to the spindle or axle C, which also carries the chain-wheel D and the ratchet F, in which engages the pawl G, to sustain or release the load at will by the aid of the rod or chain H. The apparatus is mounted on a carriage J travelling on rails. The scoop is loaded with coal and balanced in the carrier E. The rope A is then wound on the drum B by the action of the chain-wheel D, until the scoop is raised on a level with the mouth of the retort, in which position it is retained by the pawl G engaging the ratchet F. The scoop, after being driven home in the retort, is inverted and withdrawn, replaced in the carrier E, and lowered for refilling by releasing the pawl from the ratchet by means of the chain H.

Incandescent Gas Lighting.—Boult, A. J.; a communication from E. Salzenberg, of Crefeld, Germany. No. 15,818; July 19, 1898.

This invention (the specification of which is not illustrated) is intended to provide a ball-shaped light "emitting its rays radially in all directions in a uniform manner." This is attained by using gas under pressure—preferably at least 1 atmosphere or more in excess of ordinary atmospheric pressure—in combination with an incandescent body having a somewhat spherical shape, or which, owing to its construction, is caused by the high-pressure gas to assume a shape enabling the light to have a more or less "ball" shape.

The use of high-pressure gas has been already suggested by others, says the patentee, but the pressure has always been very small—only a fraction of an atmosphere—as the generally used incandescent bodies could not withstand a higher pressure. As, however, the shape of the incandescent body was not changed, only "the horizontal radiations peculiar to incandescent gas-light were attained." A suggestion has also been made to secure the incandescent body to a platinum wire netting surrounding it, for the purpose of increasing its strength; but this was merely to protect the incandescent body against breakage from shocks and vibration.

To carry the present invention into effect, burners of the well-known construction are used; but the incandescent bodies are made with as small a mesh as possible, or two ordinary incandescents may be superposed one over the other, so that the meshes of one are partly covered by the threads of the other, and in this way narrower meshes are produced. The bodies are secured to the burner by threads of asbestos or wire, so that the high-pressure gas cannot blow them off the burner. The means of securing them must, however, admit of the shape of the incandescent body being altered to a more or less spherical or spheroidal shape when it becomes inflated by, or subjected to, the pressure of the gas. The force of expansion of the escaping gas after leaving the burner acts from a point at some distance above the top of the burner, and imparts to the mantle a more or less spherical shape; and the whole surface of the incandescent body is rendered uniformly incandescent. At the same time its illuminating power is said to be considerably increased, "being about twenty times as strong as that given by the ordinary mantles, with the ordinary gas pressure. An incandescent gas light which, with the normal gas pressure, is of about 50 to 60 candle power, gives, with the process according to this invention, an illuminating effect equal to about 1000 to 1200 candles."

APPLICATIONS FOR LETTERS PATENT.

25,584.—Dossetter, W. J., "Acetylene gas-generators." Dec. 5.
25,588.—Tillotson, G., "Automatic gas-regulator and anti-fluctuator." Dec. 5.
25,600.—Yeadon, A. E. N. & S. N., "Coal-washer." Dec. 5.
25,653.—Voelker, W. L., "Incandescence mantles." Dec. 5.
25,654.—Griffin, A. B., "Incandescent gas-burners." Dec. 5.
25,664.—Yates, H. J., "Gas-taps." Dec. 6.
25,681.—Irwin, W., and Leather, J. P., "Extracting naphthalene from coal gas." Dec. 6.
25,721.—Holmes, W., and Stevens, C. R., "Heating and cooking apparatus for coal, gas, or other fuel." Dec. 6.
25,750.—Barnikel, P., "Time apparatus for extinguishing gas." Dec. 6.
25,771.—Elworthy, H. S., and Lane, H., "Producing lighting, heating, and power gas." Dec. 6.
25,782.—Strutt, J. W., "A rotary explosive motor or multicycle gas-engine." Dec. 7.
25,800.—Beechey, C. G., "Gas or oil engines." Dec. 7.
25,821.—Bickerton, H. N., and Bradley, H. W., "Gas-engines." Dec. 7.
25,853.—Thompson, W. P., "Generating, purifying, and storing acetylene gas." A communication from G. Thuillier and A. Aubry. Dec. 7.
25,866.—Dowson, J. E., "Gas-washer." Dec. 7.
25,885.—Hallows, S., and Tucker, A., "Acetylene gas-lamps." Dec. 7.
25,909.—Armour, L. H., "Prepayment meters." Dec. 8.
25,913.—Akerman, W. F., and Normanton, A., "Apparatus for the lighting up of streets and other places." Dec. 8.
25,916.—Fyffe, T. L., "Gas-stoves." Dec. 8.
25,917.—Beggs, D. C., and Fielding, W., "Manufacture of acetylene gas." Dec. 8.
25,946.—Hill, H. C., "Acetylene gas generators and lamps." Dec. 8.
25,968.—Claude, G. M. A., "Purifying, storing, and utilizing acetylene." Dec. 8.
25,982.—Salisbury, H. P., "Burner for incandescent gas lighting." Dec. 8.
25,997.—Jellett, H., "Acetylene generator." Dec. 9.
26,011.—Urquhart, R. J., "Lighting lamps and lanterns." A communication from M. Rete-Meyer. Dec. 9.
26,018.—Adamson, A. G., "Holders for supplying high-pressure gas to incandescent mantles." Dec. 9.
26,034.—Colbran, J. B. "Anti-vibration cup and ball and anti-vibration connector gas-fitting." Dec 9.
26,061.—Bradley, C. S., and Jacobs, C. B., "Manufacturing benzene, anthracene, and other polymerized products of acetylene." Dec. 9.
26,141.—Joselin, J. E. & E. L., and Wild, M. B., "Washing coke and other materials." Dec. 10.
26,152.—Abel, C. D., "Liquid-meters." A communication from La Compagnie Generale des Compteurs (Société Anonyme). Dec. 10.
26,155.—Hooker, W., "Incandescent gas-burners and apparatus used therewith." Dec. 10.
26,165.—Glover, R. T. & J. G., "Time measures for gas-stoves and other lighting with coin-freed mechanism." Dec. 10.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Carburation of Coal Gas.

SIR,—I appreciate the courteous manner in which Mr. Botley replies to my letter of last week; and if it can be called a controversy, it is gratifying to have it conducted on such friendly terms. I have to thank Mr. Botley for his invitation to visit the works at Hastings.

Mr. Botley is not disposed to accept the theory that his process and that of Mr. Beilby, referred to in my letter, are substantially identical, both in their mechanical and physical modes of action, and that both are processes of scrubbing the gas; but I am yet hopeful that those interested and engaged in the gas industry will be fairly satisfied regarding the matter. Mr. Botley tries to differentiate his own and Mr. Beilby's process, and their possible action, by a reference to the relative fineness of the states of the division of the solvent oil sprayed into the gas; but the following extract from Mr. Beilby's patent specification shows that even in this respect the processes are practically identical. Mr. Beilby says: "A stream of compressed gas or air issues from the jet-piece in such a manner as to break and carry forward the solvent in the form of a cloud of spray. This cloud of spray may be allowed to mingle with the gas to be acted on in a tower or other chamber; the mixed gas and spray being afterwards led into a succession of vessels in which the spray may subside, carrying with it the soluable matters abstracted by it from the gas."

The fineness of the division of the solvent oil in Mr. Beilby's process is here described as a cloud. Mr. Botley describes it as a mist. Both words represent matter in an extremely fine state of division; and there can be no doubt that the oil present in the gas in both cases would have identically the same action. Mr. Botley practically admits as much, when he says that a spray of oil such as he uses in his process, however fine, will deprive coal gas of some of the hydrocarbons. This is substantially equivalent to saying that oil in the form of a cloud or mist will have this effect. It is, however, a fact that neither process attains its object; and Mr. Botley himself admits that his is defective, for he collects in his drip-wells oils which are loaded with hydrocarbons absorbed from the gas in sufficient quantity to make it worth his while to transfer them to his water-gas plant. But in his letter of last week, there seems to be an inclination to persuade the reader that the whole of this oil, except a portion "too small to be evident," is carried forward to the burners for the enrichment of the gas. The only essential difference between Mr. Beilby's and Mr. Botley's process is that the former purposely passes the gas through a succession of vessels to allow the cloud of solvent oil to be precipitated by gravitation out of the gas, while Mr. Botley passes his mist of solvent oil into the current of rapidly moving gas leaving the works, with a view that it may not permit its precipitation.

I have never questioned the success of Mr. Botley's process in preventing naphthalene being deposited in the solid form, when a sufficient quantity of oil is sprayed into the gas in a fine enough state of division. In a former correspondence which appeared in the "JOURNAL," I tried to explain the physical reasons why lighter oils than those used by Mr. Botley with a high vapour tension, when used as carburetting agents in the gas, in the form of a true vapour, had a different effect and failed to prevent naphthalene being deposited in the solid form. What I did question was Mr. Botley's theory that the success of his process was due to the creation of an artificial vapour tension, by spraying into the gas as a mist oils having a low vapour tension—a theory consistent with no known physical law. I tried to show that the result was due to another cause—the lowering of the vapour tension of the naphthalene, and to its being taken up in solution by the mechanical mist of solvent oils; and that, although the process prevented the deposit of napthalene, it was not an ideal process due to the liability of the mechanically created mist of oil to be precipitated out of the gas, in positions likely to give trouble. It appears to me that Mr. Botley would do better by taking Mr. Beilby's plan, and getting the mist of solvent oil as far as possible precipitated before the gas leaves the works, unless his object is to get the solvent oil brought into contact with solid naphthalene that had been previously deposited in the mains, so as to dissolve it and carry it to the drip-well.

WM. YOUNG.

Priorsford, Peebles, Dec. 16, 1898.

Prepayment Meters.

SIR,—Now that so much useful information has been written respecting the "forging ahead" of the slot meter and cooker, it may encourage the managers of many small towns, with a population of 10,000 and under, to see what has been done during the past four years in Aylesbury, where gas is sold to the prepayment consumers at the rate of 19 cubic feet for a penny. The results are as follows:—

In 1895	£20	18	3
„ 1896	228	11	7
„ 1897	665	3	11
„ 1898	1100	8	2

The above represents the amount taken from the meters each year, and has increased the number of consumers 100 per cent.; making a total of 570 prepayment meters. To obtain these results, two exhibitions and courses of cookery lectures have been given; and there has been a large distribution of specially prepared literature, which was considered necessary in a town which is purely agricultural. Yet there is still room for a much wider extension in this particular department of our business.

Now, what does this mean to the community at large? It means an expansion of trade throughout the country. The additional supply of gas creates more labour, demands larger mains, a greater number of services, increased manufacture of gas fittings and meters, additional retort power, and further storage room. This trade then goes out to the Black Country, to supply all the necessary ironwork for the different departments. It is the same with retorts and fire-bricks. The revenues of the railways are also increased by augmented freights. This is multiplied in proportion by every town in Great Britain which takes up the lucrative business of supplying gas in pennyworths.

GEORGE LANE.

Aylesbury, Dec. 14, 1898.

Slot Cookers and All About Them.

SIR,—In Mr. Richmond's concluding article on the above subject (see *ante*, p. 1286), I notice a remark respecting Huddersfield, that we are in harmony with Hull, Leeds, and other go-ahead towns. Passing over the fanciful pun of Mr. Richmond's wit with my name, I should like to say that Huddersfield was one of the first of the 33 large towns in the United Kingdom to supply and fix slot cookers free, with 30 cubic feet of gas for a penny. I was fully satisfied as to the advisability of doing so; and my experience since the adoption has fully justified the step.

In some towns, the penny-in-the-slot plan may be deemed undesirable. The ready-money payment system, however, so commends itself to many consumers that it is apparent this system will enormously extend, and is, indeed, only in its infancy. The economizing of gas, apart from the payment question, together with the possibility of an allowance per week for gas, will recommend it in cases where economy of consumption is especially desired. In some workshops, it is the practice to check the gas used by recording the registration of the meter periodically. With the slot meter the lessening of the light constitutes a gentle reminder that a definite quantity of gas has been used, which alone becomes a check. Possibly it is the absence of any such check or hint in the case of ordinary consumers, that leads to dissatisfaction when the account is presented. In cases where a slot meter has materially increased the consumption by the facility afforded through the medium of the cooker, there cannot arise any dissatisfaction with the amount. The consumer knows at the time the reason of the increase, instead of, as in the case of ordinary collection, when some months have elapsed, and he may be unable to recollect cases of illness, escapes, or exceptional circumstances which have been responsible for the additional consumption. It has occurred to me that an automatic arrangement might be fixed to ordinary meters for checking the consumption for (say) every 1000 or 10,000 cubic feet of gas, for the purpose of notifying to the consumer the consumption from time to time. In the vast majority of cases, such an arrangement would probably be a nuisance.

My experience is that supplying a free slot cooker ensures just double the gas being consumed through the automatic meter than was formerly the case. An approximate average in this town is 10,000 cubic feet per annum without the cooker, and 20,000 cubic feet with it. I am glad to hear that other places have obtained a much larger consumption. During the past two years in this town, nearly 3000 slot meters have been fixed, which are giving every satisfaction. In face of the keen competition of other illuminants, it is evidently desirable to do everything which can possibly be done to popularize the use of gas.

EDWARD A. HARMAN.

Huddersfield, Dec. 14, 1898.

Automatic Installations and Landlords' Consents.

SIR,—We have had considerable experience of the difficulties and delays attending the obtaining of landlords' consent to the fitting up of dwellings with gas-pipes, and also for the fitting up of houses with automatic installations. These consents we have, upon various occasions, been instructed to obtain by different gas departments. It is also, I believe, the custom of many gas companies, up and down the country, to issue a printed form for the landlords' consent.

I am writing to ask whether this is really required, as the Gas-Works Clauses Act of 1847, and also the Act of 1871 (under which the majority of gas companies work), requires all gas companies to supply gas upon application, providing the applicant complies with the conditions of the local gas department. The Act does not in any way refer to the landlord's consent; the tenant's application being the absolute factor in the matter. And further, seeing that the landlord must prove damage to his property by the installation before he can call upon the company to remove the pipes, it would appear that the time and trouble taken to obtain landlords' consents, are unnecessary.

The importance of this subject is, I believe, Sir, far-reaching; as you will agree that every obstacle should be removed from the path of a would-be consumer. I need only instance Manchester and Plymouth, where endless trouble is caused on this score; landlords having frequently refused their consent.

Then again in Mr. Andrew Dougall's paper on the "Popularization of Gas" (see "JOURNAL," June 16, 1896), reference is made to a form to which the landlords' consent is needed (proving the prevalence of this custom), as follows: "He shall also be paid an additional two shillings (2s.) as commission for each new consumer obtained by him, for which he shall obtain the signature of the landlord to the printed 'form of consent' provided by the company."

The topic possibly may be of sufficient interest to induce correspondence from your readers on both sides of the question, as to the right of gas companies to fix stoves and automatic supplies without the landlords' consent.

E. W. T. RICHMOND.

Dec. 16, 1898.

Fire Risks Attending the Use of Gas-Stoves.

SIR,—I wish to call the attention of gas companies and others to a case of what might have been a disastrous fire, only that it was noticed and checked in time.

It appears one day last week, at the house of one of our consumers, a gas-stove was in use in an upstairs kitchen. After it had been lighted some time for roasting, flames were observed coming out of the ceiling ventilator of the office underneath. On further investigation, the ceiling of this office and the joists were found to be on fire. The stove (which had been in constant use for nearly four years) stood on a large piece of sheet iron, resting on a boarded floor, which was covered with floorcloth. Between the joists and the floor was a layer of black roofing felt, which it is supposed was in some way the cause of the fire; but how, it is impossible to find out, as on the day in question there was nothing unusual being cooked, neither was there any escape of gas.

E. S. PIKE.

Reigate, Dec. 14, 1898.

The Assessment of the Prescot Gas Company's Undertaking.—At the last meeting of the Assessment Committee of the Prescot Union, Mr. Newbigging objected to the assessment of the Prescot Gas Company's undertaking. The Committee eventually decided to reduce the rateable value from £961 to £743.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Tuesday, Dec. 13.

(*Before Mr. Justice* ROMER.)

Incandescent Gas-Light Company, Limited, v. New Incandescent (Sunlight Patent) Gas Lighting Company, Limited.

This was a summons on behalf of the defendants for leave to amend their statement of defence and particulars of objections.

Mr. BOUSFIELD, Q.C., Mr. ROGER WALLACE, Q.C., and Mr. WARD COLERIDGE appeared for the applicants; Mr. T. TERRELL, Q.C., and Mr. WALTER represented the respondents.

Mr. BOUSFIELD said the defendants had pleaded that the plaintiffs' patent was invalid because the patentee was not the first and true inventor, and, further, that the invention was not new at the date on which it was taken out—viz., Jan. 12, 1891. The patent under which the defendants worked—that of Carl Dellwik—was taken out on Feb. 8, 1890; and they wished to amend by pleading the specification as a prior grant. He submitted that he was entitled to raise any legitimate defence; and this being a good defence, he ought to be allowed to plead it.

His LORDSHIP said he was not in the habit of allowing amendments unless he saw there was some substance in them.

Mr. BOUSFIELD said an action on the same point came before Mr. Justice Wills; and, after evidence had been given, it was withdrawn. Since then the plaintiffs had amended their patent, and brought another action. The case made then was that, though the defendants had a combination which was included in Haitinger's patent, they had so many other combinations that one would have to pick out this particular combination, and find that it was the best. Dellwik's patent included, among other things, chromium, zirconium, and aluminium; and the defendants wished to say they had a grant to use these metals, and to show that the plaintiffs' patent had been anticipated.

His LORDSHIP: You should have pleaded user.

Mr. BOUSFIELD said he did not think there had been any user. The other side would say: "Although this was published, it does not publish the particular combination which we have found to be the best."

His LORDSHIP: If you have not used it, it must rest on the specification.

Mr. BOUSFIELD said he wished to raise the point of the difference between "prior grant" and "prior publication." The defendants had a prior grant of the right to use aluminium, zirconium, and chromium in combination.

Mr. WALLACE said, if publication were pleaded, the proper way to do it was by putting the prior specification in issue; but this did not put the patent in issue. Defendants were the owners of Dellwik's patent. The specification was merely a printed document, just the same as if printed in a book in the British Museum. Apart from any publication, defendants alleged that the Crown had made a grant to them which allowed the use of this combination; and this being so, the grant could not afterwards be made to someone else. That was the whole question.

Mr. TERRELL pointed out that Dellwik's patent had been amended by striking out the complete part of the specification, and there was no prior publication in the specification before amendment, because Mr. Justice Wills had held that the document was nonsense. Thereupon the defendants went to the Comptroller and the Law Officers, and persuaded them to so amend Dellwik's specification as to make the invention a different one; and they now wished to say that the invention as altered was a grant to them, and that the propriety of the amendment could not be questioned, as the date of it referred back to that of the original grant.

His LORDSHIP: You do not want the point raised, as it may be a difficult one to meet.

Mr. TERRELL: I do not say that. By raising the question of "prior grant" we shall have to tackle the validity of Dellwik's patent.

His LORDSHIP: All this seems to show that there is a serious point to be tried.

Mr. TERRELL remarked that the defendants wished to say that prior publication was not enough, because the invention was so concealed in the original complete specification that there was danger the Court might say it was not published; but, at the same time, they wished to say they had made an amendment.

His LORDSHIP said the argument appeared to amount to this—that there was a serious question to be tried; and the plaintiffs thought it hard that they should have to try it.

Mr. TERRELL contended that the amendment of pleading was a matter of discretion for the Judge; and the case having been set down for trial, the Court would not allow something to be pleaded which had arisen since the action, as it would involve the plaintiffs in enormous cost.

Mr. WALTER pointed out that there was a petition pending for the revocation of Dellwik's patent.

His LORDSHIP, allowing the amendment asked for, said he should order the petition for revocation to be tried before the action, as, in the event of the patent being revoked, it would dispose of the whole case.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Thursday, Dec. 15.

(*Before Justices* WILLS *and* BRUCE.)

The Stamp Duty on Policies of Insurance under the Workmen's Compensation Act.

Their Lordships, sitting as a Divisional Court, had before them last week two appeals from decisions of the Commissioners of Inland Revenue raising an important question under the Workmen's Compensation Act. The first action was by the Lancashire Insurance Company.

Mr. COHEN, Q.C., and Mr. F. L. WRIGHT appeared for the appellants; the SOLICITOR-GENERAL (Sir R. Finlay, Q.C.), with Mr. DANCKWERTS represented the Crown.

Mr. COHEN, in support of the appeal, said the case raised a point of considerable importance to Insurance Companies and also to employers of labour. It appeared that Messrs. Wren, Rogers, and Co., iron and metal merchants, of Smithfield Street, Birmingham, employed two workmen, to whom they paid £127 8s. per annum as wages. In consequence of the passing of the Workmen's Compensation Act, the firm took out a policy with the appellants indemnifying them against full liability under the Employers' Liability Act, 1880, the Workmen's Compensation Act, 1897, and also against liability at common law. The premium charged was 9s. 6d. per cent. The Commissioners of Inland Revenue held that the instrument was not "a policy of insurance for any payment agreed to be made upon the death of any person only from accident or violence, or otherwise than from a natural cause, or as compensation for insurance against accidents," as defined in section 98 of the Stamp Act, 1891, and was not chargeable by reference to the head of charge "Policy of Insurance against Accident and Policy of Insurance for any Payment agreed to be made during the Sickness of any Person, or his incapacity from Personal Injury," in the first schedule to the Act. They consequently decided that it was liable to a duty of 10s. as a deed. The learned Counsel admitted that, under the section, the policy in question was only liable to bear a penny stamp, because it merely indemnified the employer against payment in the event of an employee being killed or incapacitated by accident.

The SOLICITOR-GENERAL contended that the object of the section was to encourage individuals to effect insurances against accidents in order that their families might get payment in the event of their death. It was never intended to apply to the case of an employer who desired to be indemnified against any compensation he might be called upon to pay to any one of his numerous workmen.

The second action was brought by the Vulcan Boiler, &c., Company; but the question there was whether a penny or a sixpenny stamp was required—the policy not being under seal. In support of the appeal, it was urged that a penny stamp was sufficient.

Mr. JELF, Q.C., and Mr. J. E. BANKES appeared for the appellants; the SOLICITOR-GENERAL and Mr. DANCKWERTS represented the Crown.

In both cases their Lordships reserved judgment, which was delivered this morning in favour of the Commissioners.

Justice BRUCE said: In these two cases the instruments are chargeable respectively with stamp duty—in the one case as a deed, in the other as an agreement, unless the instruments fall within the description of "policy of insurance against accident" given in section 98 of the Stamp Act, 1891. "Policy of insurance against accident" means, according to the section, a policy for any payment to be made upon the death of any person otherwise than from a natural cause, or as compensation for personal injury. In substance, I think there is no distinction to be drawn between the two policies in point of form. But I will take the policy in the case of the Lancashire Insurance Company, the form of which is certainly quite as favourable to the appellants as the other. The proposal, which is declared in the recital at the commencement of the policy to form the basis of the contract, is described as a proposal for an indemnity against claims for compensation for personal injury sustained by workmen. The operative part of the policy binds the assurer "to pay for, and on behalf of, the employer such sums as the employer shall become liable to pay under or by virtue of the Employers' Liability Act, 1880, or the Workmen's Compensation Act, 1897, or under or by virtue of the common law in respect of personal injury caused in the business carried on by the assured in their business of metal merchants to any workmen in the employ of the assured, or of any sub-contractor, for injury to whose workmen the assured may be liable." It is quite clear, upon the wording of the policy, that the payment agreed to be made depends upon the liability of the assured to answer for the death of his workmen or for the personal injury sustained by them. The death of a workman in the employ of the assured might be caused by other than natural causes; or such workmen might sustain personal injury, and yet no payment would become due under the policy unless the death or the personal injury were caused in such circumstances as to render the assured liable to pay compensation. The payment, therefore, is not, I think, a payment agreed to be made upon the death of a person otherwise than from a natural cause, or as compensation for personal injury, but is a payment agreed to be made as an indemnity against claims for compensation for which the assured is answerable. Two things must happen. There must, first, be the death or personal injury of a workman; and, secondly, there must be a liability on the part of the assured to make compensation for the death or personal injury. It was argued by Mr. Cohen in the one case and by Mr. Jelf in the other that, though the two conditions must exist before the policy could become operative, yet the payment stipulated for by the policy was not the less a payment to be made upon death or as compensation for personal injury merely because some other condition than death or personal injury must exist before the policy could be enforced. They instanced the case of life policies and accident policies which commonly contain various stipulations requiring certain notices to be given within a stipulated time of the happening of the death or accident, the strict observance of which is made a condition precedent to the right of action on the policy; and they contended that such policies did not cease to be life policies or accident policies by reason of the right of action on the policies depending upon some event other than the death or accident. But the answer to the argument is, I think, this—that the conditions in such cases are incidental to the subject-matter of the insurance. The governing event in those cases is the death or accident; and the ordinary stipulations to which reference was made by the learned Counsel are stipulations made with a view to fence and protect the rights of the assurer, so as to enable him to require satisfactory evidence of, or to make due inquiry concerning, the facts upon which his liability depends. They do not alter the character of the risk upon which the assurance depends. Such conditions grow out of, and are subsidiary to, the subject-matter of the insurance. But it seems to me in the present case that the liability of the assured to compensate his workmen lies at the very root of the contract. It is the cardinal event upon which the liability of the assurer to pay the money under the policy depends. It is, in truth and substance, a contract of indemnity; and, though the indemnity is against liability arising from death or personal injury, and the death or personal injury is a *sine quâ non*, and the death or personal injury is one of the conditions of the liability of the assured, yet it is not the condition upon which the liability of the assurer depends—it is not the condition upon which, by the terms of the instrument, the payment agreed to be made depends.

Justice WILLS added that, even if the instrument fell within the first

part of the definition of policy against accidents, there would still remain another part of the policy which would not come within the rest of the definition. The liability of the employer to pay could not, by any reasonable stretch of words, come within the definition. The appeal must therefore be dismissed.

Incandescent Gas-Light Company v. Hawes.

This action came before Mr. Justice Romer last Saturday as a short cause upon motion for judgment in default of defence. The case had stood over on several occasions, as defendant (who appeared in person) said he had not been served with a statement of claim. He now said he did not wish to put in any defence. Mr. Walter mentioned that the action was brought to restrain infringement of the plaintiffs' 1885 and 1886 patents by the defendant, who carried on business at Finsbury Pavement. His Lordship granted the usual injunction, directed an inquiry as to damages, made an order for delivery up of the infringing mantles in the possession of the defendant, and gave costs as between solicitor and client.

Disputed Water-Rates at Eastbourne.

The action of *The Eastbourne Water-Works Company v. Sherrard*, which was brought to recover water-rates under circumstances already recorded in the "JOURNAL," was in the list for judgment to be taken by consent last Tuesday, before the Lord Chief Justice. Mr. Danckwerts said it had been arranged that judgment should be entered for the plaintiff Company for £19 7s. 6d., in addition to the amount paid into Court, and that the defendant should pay to the plaintiffs the sum of £75 on account of costs. His Lordship entered judgment for the plaintiff Company in the terms arranged.

Rent Collectors and Water-Rates.

During the hearing of a case brought against Mr. F. J. Pepper, of Colmore Row, Birmingham, by the South Staffordshire Water-Works Company at Smethwick last Wednesday to recover £6 4s., water-rate for two quarters, an interesting point was raised. Mr. Pepper admitted his liability for one quarter's rate—viz., £3 2s.; but only admitted liability for 19s. 3d. in respect of the other. He said he had been collecting the rents; but the property had changed hands in October and therefore he was no longer liable. He was not the owner; and he had no money of the owners with which he could pay the rate. Mr. F. W. Davies (collector) said that under the Act of Parliament the Water Company had a preferential claim upon the property, and had power to collect the rents in settlement of their account. Under the Act, the person collecting the rents was held to be the owner; and Mr. Pepper was collecting the rents for a month after the rate was due. Mr. Pepper contended that he was only liable up to the time he ceased to collect the rents. He would have to pay the rate out of his own pocket; and it was an important matter for agents and collectors, as they would be liable for every rate which the owner refused to pay. Mr. Parkes (the Presiding Magistrate) said they would have to decide in favour of the Company, as Mr. Pepper did not dispute the Act of Parliament. Mr. Pepper, having been told that he could not appeal against the decision, and that he would have to enter a claim against the owners, paid the money.

Disputed Meter Registration.

At the West London Police Court last Saturday, before Mr. Rose, a lady named Mrs. Edith Caroline Touzeau, residing in New King's Road, Fulham, appeared to an adjourned summons to show cause why she refused to pay £8 1s. 8d. claimed by The Gaslight and Coke Company. The question in dispute was as to the correct registration of the meter; the defendant resisting the claim on the ground that the amount for the supply of gas was considerably more than in corresponding periods. It was contended on behalf of the Company that the Magistrate was bound by the certificates of the inspectors stating that the meter registered correctly. Mr. Bodkin, for the Company, referred to the various Acts, and argued that the General Act of 1871 must not be considered in this case, as the Company did not come under its provisions. The Sale of Gas Act, 1859, contained the only provisions giving power to test the accuracy of the meter. Unless the Magistrate relied on the correctness of the meter, the Company would be at the mercy of any consumer who raised an objection. The defendant, in giving evidence, said she did not read the back of the meter registration card. Mr. Bodkin: You come here and complain of the Company without reading the directions. Defendant: I do not know anything about the meter. I wish I did. Mr. Rose came to the conclusion that the evidence of the defendant did not outweigh that of the inspector, and he made an order for the payment of the claim without expressing any opinion whether or not the meter was conclusive evidence.

The London County Council's Water Bills.—At the meeting of the London County Council last Tuesday, the Parliamentary Committee submitted for approval drafts of the Bills to be introduced by the Council in the ensuing session, to give effect to the resolutions already passed on the subject of the London Water Supply. Mr. Cornwall mentioned that the Bills clearly indicated the policy of the Council in regard to the London Water Question; and he expressed the hope that Parliament would next year see its way to pass them into law. Mr. Whitmore, M.P., desired to make it perfectly plain that, while not opposing the approval of the Bills, he did not in any way bind himself in regard to the action he might take upon them when they came up for consideration in Parliament. The drafts of the following Bills were then approved, and the Bills were ordered to be deposited: (1) London Water (Purchase of Companies) Bill, (2) London Water (Welsh Reservoirs and Works) Bill, (3) London Water (Aqueducts and Works) Bill, (4) London Water (Finance) Bill.

MISCELLANEOUS NEWS.

CONTINENTAL UNION GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, No. 7, Drapers' Gardens, Throgmorton Street, E.C.—Mr. ARTHUR LUCAS in the chair.

The SECRETARY (Mr. F. W. Himing) read the notice convening the meeting, and also the following report of the Directors:—

The Directors have to report that at Messina and Montargis, the two stations owned by the Continental Union Gas Company, the increase in the number of consumers has again been 9 per cent. The increase in the quantity of gas sold has, however, barely reached 2 per cent.

The total spent on capital account during the year at these two stations amounts to £1190; being entirely for new mains, services, and public lamps.

At Messina, the reduction in the price of gas of 2c. per cubic metre, referred to in the last report, has further affected the profits to the extent of about £260 for six months of the year ending June 30 last.

The commerce of Messina has suffered considerably from the large decrease in the export of oranges and lemons to the United States, due to the M'Kinley Tariff.

The Union des Gaz have renewed their Concession with the Town of Albi for a further period of thirty years, in exchange for a reduction in the price of gas both to the town and to the private consumers. They have also obtained concessions for the extension of their mains to Borzoli and Quarto in the outlying suburbs of Genoa. The average length of all the concessions of the towns lighted by both Companies is now 28 years.

The amount debited to capital account by the Union des Gaz, for works finished during the year under review, amounted to about £113,000. This amount is much heavier than usual, and comprises, besides the customary outlay for additional retort benches, mains, lamps, and services, the erection of a new gasholder and tank at Genoa, and of a small electric light station at Modena, the purchase of land at Milan, sufficient to provide for all future requirements there. It also includes the amount paid for the purchase of the competing Co-operative Company outside the City of Milan. The entire supply of gas to the city and suburbs of Milan is now vested in the Union des Gaz.

The working capital of the Union des Gaz has also very considerably increased, chiefly owing to the introduction of the system of furnishing consumers, at the Company's expense, with gas-fittings and prepayment meters. The results obtained up to the present have not, however, been entirely satisfactory; sufficient time not having elapsed to render this system fairly remunerative.

The following information relates to the working of the Union des Gaz stations: The fuel used for heating the retorts shows a considerable decrease at those stations, where an opportunity has occurred of introducing the system of regenerative furnaces. The salaries and wages per ton of coals distilled show an increase, chiefly on account of labour troubles at Milan. Steps have, however, been taken to meet this difficulty by the introduction of labour-saving apparatus there. The average cost of coal has further increased nearly one shilling per ton; and recent advances in freights point to a still further increased cost of coal during the current year's working. The net value of the coke sold has decreased to the extent of 3d. per ton. The values of tar and ammoniacal liquor also show a decrease. The bad debts incurred and written off profits amount to £516; being about the same as in the preceding year. There has been a net increase of 989 in the number of public lamps. The number of private consumers on the books of the Union des Gaz on June 30 last shows the satisfactory increase of 19,215; being rather more than 20 per cent.—making a grand total of 109,512 consumers supplied by that Company at their twelve stations. The quantity of gas sold for all purposes has increased to the extent of 7½ per cent. The accounts of the Union des Gaz show that that Company have lost about £700 more than in the preceding year, through depreciation in the rate of exchange from Italy. This loss, unfortunately, is likely to be further augmented in the current year.

It will be seen, on reference to the report of the Union des Gaz, that that Company have had to again reduce their dividend to the extent of 2 per cent. Some of the reasons for the reduced profits have been mentioned above, but the principal cause is due to the fact that the reduction in the price of gas at Milan, referred to in the last report, has affected the receipts and profits during the whole twelve months of the year's working under review as against five months only in the accounts to June 30, 1897. The recent renewals of the concessions at Modena and Albi at reduced prices have also had an adverse effect on the profits.

The general results of the year's working of the Union des Gaz may be summed up as follows: A large increase of business necessitating the employment of considerable additional capital; and, on the other hand, a heavy fall in the profits, due, in the main, to the lower price charged in Milan, in return for the extension of the concession.

Turning now to the accounts of the Continental Union Gas Company, Limited, the net profits for the year ending June 30 last amount to £88,832. The available sum to the credit of general revenue is £123,306, out of which the Directors recommend a dividend at the rate of 10 per cent. per annum on the ordinary stock and of 7 per cent. on the preference stock. After deducting the interim dividends paid in July last, and paying the balance of 5 per cent. on the ordinary, and of 3½ per cent. on the preference, stocks, the amount carried forward to the new account will be £35,306. It is proposed to pay the dividend on the 4th of January next, free of income-tax.

The Director who retires by rotation is N. E. B. Garey, Esq., and the Auditors (A. T. Eastman, Esq., and I. A. Crookenden, Esq.) also retire; all of whom, being eligible, offer themselves for re-election.

The CHAIRMAN said that, as reference had been made in the report to the Union des Gaz, as well as their own Company, he thought it would be convenient, for the information of new shareholders who might be present, to explain the relations existing between the two. Their Company held 36,950 shares, or about seven-tenths of the 50,000 shares of the Union des Gaz, whose share capital was a million sterling. Their debentures stood at £729,380; and the Continental Union Company held £66,385 of this amount. The Directors of the Continental Union Company were also Directors of the Union des Gaz. There were six Directors of the Continental Union Company and four of the French branch; so that their own Company always held the majority. Nevertheless, it was satisfactory to know that they were always in the most harmonious relation with their French friends; and whenever there was anything to discuss, they either went over to Paris, or their French colleagues came over to London. Referring to the accounts, he said the profits for the year had been £88,832; and inasmuch as, in order to pay a dividend of 10 per cent. on the ordinary stock and 7 per cent. on the preference stock, £88,000 was required, they would be able to pay this, and at

the same time put £832 to the amount previously carried forward—£34,473, making it £35,306. Some proprietors might think that the Board should have declared a larger dividend, and carried forward a smaller amount. The Directors, of course, gave the matter much anxious thought; and they came to the conclusion, considering the affairs of the Company and the Union des Gaz, and the state of affairs, politically and commercially, it was wiser and more politic to recommend the dividend they had proposed in the report—viz., 10 per cent. for the whole year. He was bound to mention the reduced profits, which reduction amounted for the year to £14,464. This led him at once to speak of the condition of matters at Milan, because it was chiefly due to the lowering of the price in that city that the reduction in the profits was due. Last year he explained that, in order to obtain an extension of the concession to the exterior portion of Milan to 1925, they had to concede some of the great demands made by the consumers, and so reduced the price. They had to lower it very considerably at the time, with further gradual reductions spread over a period of thirteen years. But he would not trouble the proprietors with this matter at greater length, as it was a most complicated arrangement, dependent partly on the cost of coal, and partly on the quantity of gas consumed. The first great reduction took place in 1897; and if the proprietors would permit him, he should like to quote from what he said a year ago. The exact words were: "A reduction took place in February, 1897; and therefore it only affects five months of the accounts of the past year. It follows that it will have a greater effect in the current year; so that it is my duty to tell the proprietors that there is no prospect of an increase this year. But it is almost certain there will be a further decrease in the dividend." These were the words he used last year. The Board knew that they would have to make a reduction in price; and they also knew that they would have to pay a certain amount to the small Co-operative Society who gave the Company some little trouble on the outskirts of Milan. They were further aware they would have to pay extra wages, and a larger sum for interest on the extra amount of capital raised. All this they foresaw; but what they did not foresee was that there would be an extraordinary mild winter, that there would be riots of exceptional severity in Milan, and that there would be a strike in the coal trade in England, affecting the price of freights and of coal. Now as he had said, the reduced price of gas in Milan, Albi, and Modena affected the profits for the whole twelve months under review; and the diminution was a serious matter, amounting to £29,000. Then they had had the full effect of the 1897 strikes, which, of course, gave the Board a great deal of trouble and anxiety; and, had it not been for the energy and ability shown by all who had the management of the works at the time, the Company would have been in great difficulty—indeed, it would have been almost impossible to supply the city of Milan with gas. The result of the strikes was that the wages bill amounted altogether to £1000 more than in the preceding year. There was another matter that had given, and was giving, them a great deal of trouble and anxiety; and that was the question of taxation in Italy. The existing state tax in Italy was 2 c. per cubic metre; and there was in Milan an extra 2 c. per cubic metre which was levied by the Municipality. The Company had the right to exact the repayment of these taxes from the consumer; but naturally it did their business an immense deal of harm, as the consumers did not reason about it. They simply looked at the total of the bill, and grumbled at the amount, which they said was always increasing. The 4 c. per cubic metre might be a little confusing to the proprietors; but when he told them that it was equal to 11d. per 1000 cubic feet, they would easily understand how grave a cause the consumers had for discontent. He was sorry to say that, within the past month, they had had an intimation that the Italian Government were seriously considering increasing the state tax from 2 c. to 5 c. per cubic metre. This would affect the five towns lighted in Italy by both Companies. He need hardly assure the proprietors that the Directors would use all the means in their power to resist the imposition of this taxation. It would be in the interests of the consumers that they should oppose it. They paid the taxation; the Company did not. The Company only had the onus of collecting it. But it was extremely disheartening after they, on the one side, did their best to lower the price of gas, for the Government on the other side to increase it by these enormous taxes. Gas, of course, was now the poor man's light; and it always would be so. It would be used by all classes for other purposes—for cooking and heating—and by manufacturers; but it would essentially be, he might almost call it, the poor man's necessity. Now the Italian Government had always said that they wished to lighten the burdens on the poor. The Directors understood that they were now contemplating increasing the taxes on both gas and electricity; but mark the effect of it: On electricity, they proposed to make an increase of 66 per cent., and on gas as much as 150 per cent. He asked, Is this logical; is it fair? He could almost use the strong term that it was unjust. The Directors would use their best endeavours, in conjunction with other companies in Italy, to induce the Italian Finance Minister to reconsider the injustice and inexpediency of the proposed tax. He had spoken of the foreseen causes that had led to the diminution in the profits; and it was now his duty to speak of the unforeseen ones. There was the mild winter, which affected the sale of coke as much as 3d. per ton at all stations; and, of course, with the extended use of gas-fires, they would now feel the variations in temperature more and more. The proprietors would remember how extraordinarily warm it was during last winter; and he was afraid, so far as their selfish interests were concerned, there was not much prospect of there being any difference this winter. Then came, as if they had not had misfortunes enough, the Welsh coal strike. They had made their contracts, and favourable ones, although the price of coal went up in the North considerably, because of the want of supply in the South, while all the ships were much more employed in the North and elsewhere. Consequently, where the Company had been paying 6s. or 7s. per ton for conveying coal to the Mediterranean, they had recently to pay as much as 10s. 6d. As to the residuals, tar did badly, and ammoniacal liquor was about ½d. less per ton of coal carbonized. Then came the terrible riots in Milan; and nobody could sympathize more than the Board did with the respectable inhabitants of Milan, and the Government of the city, for the fearful bloodshed that took place. It naturally affected the Company's business. Less gas was consumed, and the street-lamps were smashed; and the Company had to pay a bill of between £300 and £400. There was also great interruption of business in the city—very much to the Company's detriment. These were the chief reasons why the Union des Gaz profits decreased, as they did, to the amount of £27,000 last year, and why they had to draw £14,000 from the reserve in order to pay the dividend, which was 2 per cent. less. Of course, there was a corresponding reduction in the amount of dividend received by the Continental Union Company from them. He must now say something about the large capital expenditure. No less than £113,682 had been required for enlarging and improving the works at all the stations of the Union des Gaz. This expenditure was, of course, needed because of the much larger demand for gas. A further amount of £156,000 was being spent for works sanctioned and authorized. The previous sum was an amount actually paid; but the other was a liability which they would have to face. Taking this into consideration, the Directors, after consulting their French colleagues, came to the conclusion that the only way out of the difficulty, as capital must be raised, was to issue new bonds. The sum of £269,682 had thus to be raised; and it would be satisfactory for the proprietors to know that these bonds, which were 500 fr. bonds, were issued at 485 frs., and with the small interest of 3½ per cent., which showed the good position in which the credit of the Union des Gaz stood in Paris. Of the large sum mentioned as having been spent, £68,980 was required in Milan; and the Directors were justified in spending this, because the increase in business in Milan was as much as 10 per cent. last year. Therefore they had had to buy a large amount of land on which to put new plant. At Genoa, as much as £12,960 had been spent on a new large holder and other apparatus. At all the other stations, too, of the Union des Gaz, there had been, he was happy to say, an increased consumption of gas. There remained, in addition to the amount of bonds issued, a balance required of £32,000; and this was met by the sale of sundry securities which had appeared in previous balance-sheets of the Continental Union Company, and which the Directors had lent to the Union des Gaz at the rate of 4 per cent. Notwithstanding all the losses and extra charges, he looked very hopefully to the future; and he did so with the firm conviction that, while they might not earn as much immediately as they expected ultimately to do, yet they would have a fair return on their capital. He was justified in saying so, because last year the increase in the consumption in the Union des Gaz alone had been upwards of 4 million cubic metres, which was equal to an increase of 7½ per cent. In the preceding year, it was much less—only 4 per cent. The increase in the number of consumers, too, had been remarkable—as much as 20 per cent. last year, against 12 per cent. the previous year. Of course this increase of one-fifth was due in a measure to the prepayment meters; and at the same time it showed that the business was in a very advancing state. The fact was the whole nature of the gas business was changing. In former years, gas was used only by those who were comfortably off; now it was used by all classes and for a great many purposes. The incandescent burners had given a great impulse to the whole business. But gas would now have to be supplied at a cheaper rate; a much larger capital would be required; and it would take some time before a fair return could be obtained for the capital. All industries must have their ups and downs, and their times of prosperity and adversity. He could assure the proprietors that the Company's business was in a perfectly sound state. They might not next year be able to pay so large a sum as they had during the past few years; but the dividend was quite safe. The profits which had been made for many years had been on the whole satisfactory. The dividend this year should not be considered a standard one; it was a dividend paid during times of exceptional trouble. The trouble might not pass away this year or next, as Italy was in a very unsatisfactory state. The proprietors must, however, remember that the Company had many other towns in France and one large town—Strasbourg—in Germany, where they were not inflicted with crushing taxes; and in these cities their business was prospering successfully. He could say—although it was a most dangerous thing to prophesy with regard to profits—that they would not pay next year a larger dividend than they were doing this year. This was certain; and they would consider themselves fortunate if they could maintain the dividend at the present figure. In conclusion he must ask the proprietors to have that confidence in the directorate that they had had in the past. The Board would do their best for the interests they had so sincerely at heart. They endeavoured always to carry out their contracts loyally—not only to the letter, but in the spirit; and he hoped this feeling would be appreciated by the foreign countries with whom they had to deal. His remarks had perhaps been somewhat discouraging; but the Board did not feel discouraged. He could only hope that, when they next met the proprietors, they would have a better report to present than they had had that day. He then moved the adoption of the report and accounts.

Mr. H. Wollaston Blake seconded the motion.

Mr. H. D. Ellis, referring to the increased taxation on gas at Milan, said they had the right to recover the tax from the private consumers; but was he correct in saying that this was not so with regard to the public supply contract. He supposed the tax had to be paid on the gas consumed by the public lamps, and that it was the Company's loss.

Mr. Lees said it appeared from the Chairman's statement that the gas was already taxed to about 11d. per 1000 cubic feet; and now there was a prospect of further taxation to the extent of 8½d. The Company, he understood, submitted to the 11d. tax without increasing the price to the consumers; and he asked whether the Directors intended to increase the price to the consumers if a further tax was imposed, or was it to come from the shareholders. He also expressed the opinion that, with only a balance of £800 to add to the undivided profits, the Directors were paying too high a dividend.

The Chairman, in reply, said the Company had to pay the tax to the Government. They had the right to collect it from private consumers; and this they did. There was no tax on the public lighting. Answering a further question, he said they were charging the maximum price for gas at present.

On the proposition of the Chairman, seconded by Mr. N. E. B. Garey, the dividends recommended in the report were declared.

The retiring Director (Mr. Garey) and the Auditors (Messrs. A. T. Eastman and I. A. Crookenden) were unanimously re-appointed.

The Chairman having moved a vote of thanks to the Secretary, Managers, and staffs at home and abroad for the able services rendered during the past year,

Mr. J. Horsley Palmer seconded the motion. He stated that during last spring he had a somewhat eventful journey on behalf of the Company, because he was summoned to Milan just as the riots were beginning to break out; and they commenced by a strike among their own workmen.

He was exceedingly pleased with the way in which the Chief Engineer and other members of the staff were prepared to meet such a grave difficulty. He also found that the other Italian stations were well manned in every respect.

The motion was unanimously carried, and duly acknowledged by the SECRETARY.

A vote of thanks to the Chairman and Directors was moved by Mr. A. T. EASTMAN, and seconded by MR. H. D. ELLIS. Their expressions of sympathy with, and confidence in, the Board were heartily endorsed by the proprietors.

A response by the CHAIRMAN concluded the proceedings.

SOUTHWARK AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held last Tuesday, at the Offices, Southwark Bridge Road—Alderman Sir HENRY E. KNIGHT in the chair.

The SECRETARY (Mr. Montague Watts) having read the notice calling the meeting, the report of the Directors, referred to in the "JOURNAL" last week, was taken as read.

The CHAIRMAN, dealing with the accounts, said he thought the outlook must be pre-eminently satisfactory to the shareholders. They had spent the whole of the £100,000 of debenture capital issued last year, with the exception of £3483. Consequently, they had expended capital at rather a larger rate during the past twelve months than before; and this became necessary because the works required to bring the Company into the pre-eminent position in which it now was, and to maintain it there, had had to be executed with greater rapidity. This showed that they were advancing more rapidly in the construction of works for which the Company had obtained the assent of Parliament; and they were therefore placing the Company in a more impregnable position. While calling attention to the question of capital expenditure, he might also refer to the position of the Company among the Water Companies of London; and he did not think he could do better than compare the amount of capital they had invested in the undertaking with the amount sunk in the undertakings of other Companies. The capital spent by them was £2,960,000; and beyond this they had parliamentary powers for another £1,000,000. Therefore, with their existing parliamentary powers, they had a concern with a capital at present of about £3,000,000 spent, while in a few years this amount would be increased to £4,000,000. Comparing this with other Water Companies (he put aside the New River Company as to capital, as that Company were in a different position to the others), they would find that the Southwark and Vauxhall Company had the largest expended capital of any of the London Companies excepting the East London; and that Company's capital was so little in excess of their own that it was about equal. The Southwark and Vauxhall Company had expended £2,960,000, and the East London Company £3,012,000. To show how pre-eminent the former Company stood in his view beyond the other Companies, he would only point out that the Company with the next largest capital expended was the Lambeth, whose outlay, however, had been £1,800,000; while the Company with the smallest expended capital was the Kent, with £1,009,000. These figures he was sure would be interesting, because they showed the important position which their Company now occupied in connection with the Water Companies of the Metropolis. As regarded the bulk of water delivered, they supplied the third largest quantity of any Company in London; and for the purposes of comparison in this respect, he included the New River Company. The figures were interesting because they brought home to the minds of the shareholders the importance of maintaining a concern which had so much more capital than other Companies, and one which supplied so much more water to London than some of them. It would also bring home to their minds the greater responsibility and difficulty which existed in connection with the management of the business. Not only so, but their business was in a district of London which was the poorest of all—just on a line with the East London Company. Their difficulties were, of course, greatly enhanced by this fact. Turning to the accounts, the first item on the debit side of the revenue account was "maintenance;" and the total of the account was £55,458. Comparing this, according to custom, with the amount for the corresponding half of last year, when it was £46,143, there was shown an extra expenditure on maintenance account this time of £9315. The increase was to be attributed to the extra amount expended on the strengthening of the 42-inch main from Hampton to Nunhead. He mentioned last year that there was some difficulty with the Government Auditor (Mr. Allen Stoneham) with reference to this matter; and they had come to a conclusion which he (the Chairman) felt was not altogether satisfactory, though it was one which he thought might be accepted. The matter involved a charge to maintenance account this half year of £5627; but it wiped away the question entirely, and removed all doubt, because it was arranged in the settlement how any further work on this main that might be necessary was to be done. This question would therefore not arise again, and the matter would adjust itself in each half-year's accounts. As he had said, this accounted for £5627 out of the total increase of £9315 under the head of "maintenance." Then they had spent a further £1500 in alterations to the boilers at their Streatham station, which was a very important one. They were now getting more than 2 million gallons of water daily from it; and they would most likely obtain more. Important alterations were wanted to the boilers there; and they had to lower the mains, which became frozen in the winter. They had done this work, and it had cost £1500, which brought up the outlay to more than £7000 out of the £9000 odd increase. Then, pumping and engine charges were £864 more; this being caused mainly by the coal strike. They were in great difficulties through this strike; and unusual care and attention were required to get fuel at all. Next there was the payment to the Thames Conservators of £525 in excess. This was in consequence of the Company's Act of 1897, under which they had to pay the Conservancy for water taken from the Thames in excess of 24½ million gallons. Rates and taxes were also again higher; the excess for the past half year being £629 as compared with the amount they paid for the six months to September, 1897. Adding all these figures together, they would find that he had accounted for the whole of the increase in the maintenance charges; and they would see that the greater part of it represented expenditure which could not come into the account again. With regard to management, the excess of expenditure over that of the corresponding half of last year was only £590; and when they looked at the law and parliamentary charges, and saw that they were £698 in excess of what they were for the corresponding period of 1897, he did not think he need go further into this account. The excess of the parliamentary charges was mainly caused by the very large expenses they were put to in order to appear before the Government Commission on the water question, so that the shareholders' interests might be properly looked after. He turned, and with very much greater pleasure, to the other side of the revenue account, where they would find that the item which was the real test of the way their business was conducted—the first item, which had to do with surcharges and allowances—showed a saving. They had saved, upon the £4500 brought forward, no less than £1579, as against a saving of £1350 in the corresponding period of the previous year. They therefore had an improvement there of £229 on this half year. The water-rents accrued to the date of the account stood at £137,960, against £131,889 for the corresponding half of last year; showing an increase of £6071 for the six months. The rents for the whole year ended Michaelmas, 1897, were £253,484; while for the year ended Michaelmas, 1898, they amounted to £264,443—being an increase in the past year of £11,000. This was a figure of startling importance to them. He had told them year after year of the almost unlimited scope that existed for increase in their undertaking; and the shareholders had had confidence in what he had said. It must, therefore, be gratifying to them to see that he could now report an increase of £11,000 in water-rents in one year. This had not come from assisting the East London Company. They did not agree to help the Company until the 18th of September; and therefore they only had what was due to them on this account for the fortnight to the 30th of the month. The £11,000 was really due to the innate prosperity of their concern. He did not say that they would always have a similar increase in twelve months; but they might rest satisfied that there would be a large increase in their water-rents year after year for many years to come. Adding the increase of £6071 which they had in the rentals, as compared with the corresponding half of the previous year, to the £229 saved from incidentals, they got a surplus on this side of the account of £6300 as compared with what they had in the corresponding period of the previous year. He then came again to the other side of the account—to the dividend and interest account for transfer of profits; and he found that this amount was £72,744, against £76,445 at the corresponding date of 1897—in other words, £3700 less was carried to dividend account than at this time last year. They would ask how it was that, when they had a surplus on the other side of £6300, they had less to take to the dividend and interest account. Well, it was through the extra expenses of maintenance and the extraordinary charges he had been speaking of; and they could test this thoroughly if they would only take out the figures themselves. They had £9315 more for maintenance, and £590 more for management charges; and the additional amount of revenue was £6300. This left £3600 *plus* for charges; but they had to take into account the difference in rents and transfer fees, and they were then brought to the exact figure of £3700, which was the amount they carried to the interest and dividend account less than at this time last year. With reference to the dividend and interest account, they were paying more for interest accrued on their debenture stock, because they had a larger amount of it issued; and a difference of £1500 more for this had to be paid. They had also paid £600 more interest on temporary loans from their bankers. This gave them a balance applicable to dividend of £52,700, against £44,633 in the corresponding period of last year. So that, though they brought down a smaller amount, they had a balance available for dividend no less than £8000 in excess of what they had in the corresponding period of 1897. The question was what they were going to do with this money—a matter over which the Board had thought very carefully; and they had decided to pay a dividend at the rate of 7½ per cent., as compared with 6 per cent. This increased distribution would leave them £14,126 to carry forward. Passing to the Directors' report, he remarked that it was a good deal longer than usual. The circumstances were, however, of such a character that they had thought it necessary to point out to the shareholders something of what they had done in the course of the past few years. They would notice that the increased rental from the domestic supplies kept up satisfactorily, as well as all other sources of revenue. He also congratulated the shareholders on the fact that, when they obtained their Act of Parliament last year, the Board rather thought it was the last of the long series they had been working for in the past twenty years—Acts which had enabled the Company to take the position they were in at the present time. They had not only during the recent drought been enabled to supply their own district thoroughly and efficiently, but at a time when, through circumstances beyond control, a sister Company found their supply reduced to such an extent that they could not satisfactorily serve their own district, the Southwark and Vauxhall Company offered their aid at the first possible opportunity, and said to the East London Company: "Lay your main through the Tower Subway, and we can let you have some 6 or 10 million gallons of water a day." He could not help remarking that the East London Company did not break down, as had been sometimes said; it was Nature that broke down, in giving them only 14 inches of rain, as against an average of 27 inches. The breakdown was also due to the dreadful system of building houses without cisterns, against which common sense revolted; and he believed this state of things would be altered. The position of the Company had not been arrived at except after years of very great and close application and promoting Bills in Parliament. Having referred to these, and also to the later measures which had been brought forward, and to the powers contained in them, he stated that the Company now had mains, reservoirs, filters, &c., as well as water. They were therefore safe in their supply; and he could see his way perfectly clearly for the next forty or fifty years. The various Bills he had mentioned were not obtained without enormous expense and labour. They were obstructed at every stage by the London County Council and others, especially the County Council. The Company never obtained power to spend a shilling of capital without proving the utmost urgency for the outlay. Coming to the present year, he said the Council had deposited Bills not only for purchasing the Water Companies' undertakings, but to bring water from Wales, though the question of purchase was still being inquired into by a Royal Commission. Could they suppose for a moment that Parliament would consider this question until they had the report

of the Commission? The fact was that the Council were going out of their way to waste the ratepayers' money, and to put the Companies to expense in pursuit of their policy to damage the latter as much as they could. With regard to the idea of going to Wales for a supply of water to London, he could speak for hours; but in the article which appeared in "The Times" of the 12th inst. the question was answered most admirably. It had also been proved before the Royal Commission that there was ample water in the Thames Valley wherewith to supply London for the next hundred years, if not for all time. The Companies would have to fight the Council's Bills; and he believed that they would fight them as successfully as they had done before. He concluded by moving the adoption of the report and accounts.

Mr. C. M. Vialls seconded the motion.

A Shareholder urged that the revenue account might be published showing the comparative figures for the corresponding period of the previous year; but a motion submitted on the subject was lost.

The resolution adopting the report and accounts was then put and carried unanimously.

Dr. Chesshire remarked that the Company were now in an eminently proud position, for which they were indebted to the Directors; and he proposed that their remuneration should be increased by £1000 per annum.

Mr. Dadswell seconded the motion, which was carried unanimously.

Resolutions were afterwards passed declaring the dividend recommended, and re-electing the retiring Directors (Mr. S. Green and Mr. Noel Whiting), and Auditor (Mr. J. D. A. Norris).

Mr. Jeffries proposed a vote of thanks to the Chairman, Directors, and officers of the Company; and the motion was carried.

The Chairman acknowledged the vote, and warmly recognized the services of the officers.

The proceedings then terminated.

GRAND JUNCTION WATER-WORKS COMPANY.

The Ordinary Half-Yearly General Meeting of this Company was held at the Office, No. 65, South Molton Street, on Wednesday last—under the presidency of Mr. Frederick Tendron.

The Secretary (Mr. J. Goodwin) read the notice calling the meeting; and the report of the Directors was taken as read.

The Chairman said he thought the accounts for the past year must be regarded as satisfactory. There was an increase in the water-rental for the half year to Sept. 30 last, as compared with that of the corresponding period of 1897, of £5996; and though there had been special expenditure during the year to the amount of £7404, they were able to carry forward, in addition to the amount they had before, no less than £5072. He wished to call attention to the fact that this sum of £12,476 was very nearly a further 1½ per cent. on the dividend that had been paid, and which they proposed declaring that day. They sacrificed as it were 1½ per cent. of present income in payments on account of work that would be beneficial to the Company in the future. The large expenditure of a special kind which they had had ever since the frost of 1895, had been mainly in connection with the frost. First of all, about £19,000 of direct expenditure was caused by damage through the frost, and as nearly as possible the same amount for lowering the mains to secure their consumers as far as possible from such a disaster in the future. The total charges in connection with the frost had been £38,201. In this special expenditure, there were two items that had particularly to be taken into consideration, with respect to the value of the property should the undertaking at any time be bought up. So far as the frost and the lowering of the mains was concerned, there was not the slightest doubt that the outlay caused was a proper charge against the profits, but not to be spread over merely the particular years during which they spent the money. The frost was abnormal. It only occurred once in thirty years; and there could be nothing more unjust than the principle advanced by the London County Council of taking the particular figures of a couple of years, knowing all the time that these two years would have a most exceptional bearing on the revenue of the various Water Companies. With respect to the Staines reservoirs, in addition to the heavy expenses they were put to for parliamentary proceedings, which were wholly exceptional and only caused by the County Council, they were paying money which ought to be capitalized. It was most unjust that they should be bearing charges out of revenue which would only be beneficial to them when the Staines works came into operation, and which would then be of assistance to them for nearly forty years. He wished to put this matter clearly, and have it recorded that they would have a claim, should they be bought up, that this payment should not affect the income of the Company during any particular year or two that might be chosen, and that they had in addition an actual revenue claim for the payments they were now making for interest and management on account of the Staines reservoirs. The expenditure during the same period—the frost—on capital account, and which had been incurred to increase the pumping power, make additional filter-beds, dulplicate mains, and lay down new mains in new districts, had come to nearly £150,000; the interest or dividend on it being charged against revenue. After they had made these various efforts to improve the supply, and to show that they were worthy of the task given them to perform by Parliament, the County Council were going to bring in another Bill for the purchase of the undertakings. The Chairman of the West Middlesex Company (Mr. Boulnois) had had the advantage of seeing the Bill; and he had characterized it as containing the most bare-faced proposal ever made by a public body. He (the speaker) thought this a sweeping conclusion; and he thoroughly endorsed it, though he could not say that he had studied the matter in the same way. He did not believe that such a Bill had the ghost of a chance of being accepted by Parliament. He now came to a matter of the greatest importance to the Water Companies—the present Royal Commission. It was not for one moment to be supposed that the men who formed the Commission had a prejudice or a desire to favour the Companies. He thought their one aim was to get information which would enable them to form a sound judgment on the main issue before them—as to the desirability or not of purchasing the water undertakings, either by the County Council or a public body. But as the Companies to a great extent were identified with the system of providing for the future by storage reservoirs in the Thames Valley, and as the County Council had almost pledged themselves to sink or swim by the scheme of water from Wales, the probability of the Commission's judgment in favour of one or the other scheme became of importance; and to the Water Companies it was of almost vital importance. If they watched the proceedings of the Progressive party of the County Council, they would realize that the quiet hostility of a very influential part of the Moderate members of the County Council was not clearly shown in the division lists, though it had been sufficiently proved that it was by a small majority that the Progressive party were able to thrust their schemes forward. Why were they so intent on pushing this Welsh scheme? and why were they so intent on getting a particular clause? Not satisfied with the ordinary clause that had for many years governed the purchase or sale of property taken compulsorily, they wanted to introduce a clause which somehow should enable the arbitrators to take into consideration a variety of points which otherwise would not be admitted; and the most important of all these points would be the cost of bringing in a fresh supply. They would say: "You have to buy these Companies not solely upon the income they have been earning, or the income they are earning, and which they will earn for a certain number of years, but you have to face that with their enormous liability to spend an amount necessary to continue their supply for the increased population in the course of the next thirty or forty years." If, however, they got their purchase, they would be ready to throw this all on one side, just as they were ready now to take 185 million gallons from the Thames, although they had characterized the supply for years as diluted sewage. He did not believe that they would be ashamed, if once they got hold of the Companies, to throw over the Welsh scheme in favour of Thames Valley storage. Mr. Hunter, who was under examination before the Royal Commission on Monday and Tuesday, submitted figures, which he (the speaker) did not seriously think were called into question, as to the relative cost of the two schemes. In both cases there was a set-off. The interest on the Welsh scheme was enormous, compared with that on the Thames Valley scheme; but the latter had so large a sum for the capitalization of the pumping compared with the gravitation of the supply from Wales, that they could set the £3,250,000 of the one against the £3,500,000 of the other. Therefore, in the figures he was going to give them, he left out entirely the capitalized cost of pumping; and he also omitted the interest. He would deal with the works alone, and on a basis of 100 million gallons a day passing over Teddington Weir in such an extraordinary season of drought as that which they had gone through. During this period, far less than 100 million gallons passed over the weir on a number of days, and yet without any serious inconvenience of any kind—in fact, without even a complaint. He wished to record that as a Conservator of the Thames, when the figures were read as to the small amount of water that had passed over Teddington Weir on various days, he asked what inconvenience had been sustained by the Conservancy. He was at once opposed by a Progressive member of the County Council and others, to prevent this question from being answered; but he insisted on a reply—if not to that question, at least to this: What complaints had the Thames Conservancy received in consequence of 52 million gallons only passing over on one day, and 70 million gallons and so on for a number of days? "Not one" was the answer of the Engineer. This point was of immense importance; and unless the question were studied, one could not realize that it would make a difference to the Water Companies of more than £2,000,000 whether the Royal Commission decided that 100 million gallons should be the limit in so exceptional a year as 1898. The public might place great reliance on the figures submitted to the Royal Commission; for the estimated cost of storage reservoirs, &c., in the Thames Valley was based on their actual contract for the Staines reservoirs. Messrs. Aird and Sons, who were the Contractors for the Staines reservoirs, would not do work without a profit; and the payments which the Water Companies would make to them were based on these figures. They could not therefore have a better ground for calculation in estimating what similar reservoirs would cost. Including with the outlay on the reservoirs all the pumping necessary to convey the water to the service reservoirs of the various Companies, and the mains that were necessary to be laid, the expense to the Companies for the Thames storage would be £4,483,000; and on the same basis the cost of a supply from Wales to Elstree, and for conveying it from Elstree reservoirs in like manner to the service reservoirs of the various Companies, would be £20,600,551. This estimate was not a fancy one; it was based on the actual experience of three great similar works which supplied Manchester, Liverpool, and Birmingham. If the County Council could get their scheme passed, they would deduct—or would, at all events, try to deduct—from the value of the Companies' properties the cost to which they would be put to bring the water from Wales. This was a point they had been driving at all along. If the supply was to be derived from the Thames Valley, even taking the necessities of those Companies who had the greatest increase, the first additional reservoir need not be commenced until 1916, so as to be finished by 1920, to meet the needs of the population based upon the calculations made by Lord Balfour's Commission. He wished the shareholders of their Company to realize what a splendid position they were in when he was able to tell them, on Mr. Hunter's authority—and their colleague had now had so much experience in all these matters—that the Company would be able to provide for the increased population in their district, by their share of the Staines reservoirs, right up to 1937.

Mr. Hunter: The assumed increase.

The Chairman assented. Continuing, he observed that he wished the public and the ratepayers would take to heart what he was now about to remark, as showing the spirit which animated the Progressive party (the working man's representatives) on the County Council. They did nothing to assist the East London Water Company in their troubles, and they did nothing to lessen the sufferings of the people who were short of water. They tried, however, to make political capital out of it. With reference to the Council's Bill, did they suppose that the first condition in it was to make provision for the East London supply? On the authority of Lord Onslow, there was not a word in the Bill about the matter. They were themselves bringing in a Bill which would enable all the Companies to have their various systems combined; and although the cost would be heavy, they were ready to face it. So far as East London was concerned, the Southwark and Vauxhall, Grand Junction, and West Middlesex Companies were going to take the responsibility of spending money at once,

even before they had parliamentary authority, if they had the proper promise he trusted to have from the President of the Local Government Board that day, so that East London would not, under any circumstances, go through such a terrible experience as that of last summer. He concluded by moving the adoption of the report.

The Right Hon. Viscount KNUTSFORD, G.C.M.G., seconded the motion.

The CHAIRMAN, in answer to questions, said no one knew when the report of the Royal Commission would be published. With regard to the assistance rendered by them to the East London Company, and the cost at which they supplied their water, it was impossible to get their work done faster than they did, and they were able to give the East London Company but little help. They made the very moderate charge of 6d. per 1000, or £25 per million gallons; but when they found that the East London Company took 129 million gallons, they voluntarily reduced the rate to 4½d. per 1000 gallons.

The motion was then put and carried unanimously.

The CHAIRMAN next proposed the declaration of a dividend for the last financial half year at the rate of 7½ per cent. per annum on the £50 "A" shares and on the £25 "B" and "C" shares, and of 7 per cent. per annum on the £50 "D" shares; together with interest and dividend, in accordance with the conditions of sale, on the 600 new £50 "D" shares offered at public auction on the 18th of May last.

Mr. H. MOTT seconded the motion, which was carried unanimously.

Dr. LEESON then proposed a vote of thanks to the Chairman and Directors for their arduous services. They were greatly indebted to Mr. Hunter for having saved the Water Companies; and he considered that everything was due to his and the late Mr. Fraser's scheme, which was so ably carried out.

Mr. PEARCE seconded the motion, and it was carried unanimously.

The CHAIRMAN, in acknowledging the vote, said they would go on fighting their friends the London County Council as long as they had any strength left.

The proceedings then terminated.

FALMOUTH CORPORATION AND THE GAS AND WATER COMPANIES.

Now that the vote of the ratepayers has disposed of the scheme of the Falmouth Town Council for the purchase of the gas and water works some members of the Corporation seem anxious to harass the Companies and take up a hostile attitude in the hope that something may ensue. At a meeting of the Council on the 8th inst., Dr. Banks proposed that a Water Committee should be elected, "whose duties amongst others shall be to report frequently to the Council on the quality and quantity of the water supply of the borough; and to confer with the Board of the Falmouth Water Company on all matters affecting the supply." His object was very reasonable; for, as he explained, it was thought by himself and others that as the question of the proposed purchase of the waterworks was decided, a conference with the Directors as to the supply would result in good. The idea was simply to keep the Council in touch with the Water Company. Mr. T. G. Mead seconded the motion, and expressed surprise that the idea of taking such a step had not occurred to any of them before. Other members, however, were not in this conciliatory mood. Mr. W. J. Coombes said the proposal was very crafty, but the effect of it would be to relieve the Water Company of their responsibility for the maintenance of a pure and abundant supply of water. As an amendment, he proposed that the suggested Committee should be called the Water and Gas Committee; and that their duties (among others) should be "first, to obtain when requisite, analyses of the water supplied to the Company, and also to periodically inspect the sources of supply; secondly, to ascertain the illuminating power of the gas supply, and the amount of impurities contained therein—such as sulphur compounds, the amount of hydrocarbons other than those derived from the destructive distillation of coal, and also the amount of that most deadly and poisonous gas known as carbon monoxide; thirdly, to meet when convenient and formulate a mode of procedure, and submit the same to the Council for their approval." Mr. Mackenzie, who seconded the amendment, revived the memories of recent controversies by his assertion that the quality of the gas was "worse than very poor." Mr. Grose, who acted as Chairman of the Gas and Water Purchase Committee during the two abortive attempts to win the support of the ratepayers to the scheme, asked if the resolution would empower the proposed Committee to go in for the purchase of the water-works. Dr. Banks replied that that was not his intention at all. To remove any doubts upon the subject, he proposed striking out the words "amongst others," and adding to the resolution: "It being understood that the Committee shall in no way interfere with the functions of the Gas and Water Purchase Committee." On a vote being taken, six voted for the resolution, and six for the amendment. The Chairman gave his casting vote for the resolution, which was accordingly carried. Mr. Grose will, however, move at the next meeting that it be rescinded.

The Rating of Reservoirs and Mains in Various Townships.—The Dewsbury and Heckmondwike Water Board are about to appeal against the rating of their reservoirs and mains in the townships in which they are situated. The Board have contributed rates to several Local Authorities; but the Clerk (Mr. G. Trevelyan Lee) has advised them that the reservoirs and mains are not liable to be rated. We learn that Mr. Balfour Browne, Q.C., who has been consulted on the matter, agrees with Mr. Lee. Notices of the appeal have been served; and should the Board be successful, about £1100 a year will be saved.

Brigg Gas-Works Purchase.—A poll of the inhabitants of Brigg has been taken in connection with the proposal to purchase the gas-works, and has resulted in a majority of exactly two to one in favour of the Council proceeding in the matter. The figures were: For the purchase 386, against 193. The cost of the undertaking, as estimated by Mr. E. H. Stevenson, the Engineer retained by the Council, will be £15,000, exclusive of law expenses. On the other hand, those opposed to the proposal say that the total cost to the town will be nearer £25,000. The shareholders of the Company have, it is reported, authorized the Directors to spend £2000 in oppposing the Council's Bill.

ELECTRIC LIGHTING NOTES.

The Bradford City Council have decided to spend £4150 on two additional engines and dynamos for their Valley Road electricity works.

The Shrewsbury Town Council have received a letter from the Local Government Board sanctioning a loan of £30,463 for the purchase of the local electric lighting works.

Through a singular freak in the electric light supply of High Wycombe, Bucks, on Monday night last week, the place was suddenly plunged into darkness. The lamps in the main streets of the borough and on the highway from London went out, with a few exceptions, just before ten o'clock, those which remained only making the surrounding gloom more apparent.

Last Thursday witnessed the completion of the purchase of the Yorkshire House-to-House Electricity Company's undertaking by the Leeds Corporation. At the Company's offices in Whitehall Road, possession of the works and premises was formally handed over to Mr. J. G. Hirst, Deputy-Chairman of the Lighting Committee, acting on behalf of the Corporation, in the presence of representatives of both parties. The total amount of the purchase money was £222,987 18s.

Mr. E. A. S. Fawcett conducted a short inquiry at Chester last Friday into an application by the Corporation for authority to borrow £20,000 for electric lighting extensions. The evidence laid before him showed that loans amounting to £45,000 had been already obtained; but the total expenditure incurred, owing to extra mains, lamps, &c., required, amounted to above £48,000. The Lighting Committee, it was also mentioned, were constantly receiving applications for the installation of the light in different districts. There was no opposition.

For the second time within three months, the electric light failed last Friday night at Norwich. About five o'clock the light was very irregular—almost dying out, and then suddenly giving an intense light. After this erratic behaviour, it collapsed entirely at six o'clock. Two hours afterwards an attempt was made to restore the light; but, by some mistake (as a local reporter puts it) "a too strong current was put on," and considerable damage was done. Several explosions took place; ceilings, plates, and fuse-boxes being blown off, and woodwork scorched.

The "Financial News" last Tuesday reported that a good deal was doing in electric shares, and went on to say: "St. James's, Westminster, Chelsea, and Citys were in demand; but Metropolitans were ¼ lower. The fact that in many City offices gas was being used yesterday (Monday) afternoon and evening, owing to the bad light supplied by the Electric Companies, makes the strength of their shares all the more remarkable, unless, indeed, some of them hope to profit by giving a poor supply." On the following day, our financial contemporary explained that the bad supply of electricity previously referred to was "caused by the enormous demand for current." The machinery is stated to be overloaded, owing to nearly 3000 new lamps per week having been added. The blame for the present deficiency is laid on the engineers' strike.

The borough of Eccles was put in possession of the electric light last Wednesday. The undertaking has been carried out by the Corporation at a cost of something like £12,000. The plant consists of two Lancashire boilers and two steam alternators, each of 200-horse power, and each capable of supplying 4800 8-candle power lamps. The engines are of the marine inverted type; and the accumulators are of a capacity to maintain 1000 8-candle power lamps for seven hours. The system of distribution adopted is the high-tension alternating current, at a pressure o 2000 volts, which is reduced on the consumers' premises to 200 volts. It is intended to carry out the whole of the public lighting of the borough by electricity; and this will involve a supply of some 1700 lamp columns. At the present time, there are about five miles of mains laid in the district; and applications have been received for about 4000 lamps. In all, 30 miles of streets will eventually be lighted.

The expediency of applying for a Provisional Order to authorize the supply of electricity for public and private purposes in the borough and carrying into effect any agreement which might be arrived at for purchasing the undertaking and works of the Electric Lighting Company was considered at a special meeting of the Eastbourne Town Council on Monday last week. Several members were absent owing to their connection as shareholders with the Company. Mr. Maude moved a resolution in accordance with the object of the meeting. He sketched the history of the subject from March last; and, with regard to a complaint that the Corporation were proceeding with the Order when negotiations with the Company were in progress, he pointed out that, if the Council did not do so, they would lose a year of precious time, while they might any moment abandon the Order if, as they all hoped, they should come to an amicable arrangement with the Company. The resolution was carried.

The wisdom of the policy of the Electricity Committee of the Liverpool Corporation in laying down small generating stations instead of making one huge establishment of them was questioned by a member at the meeting of the Council last Wednesday. The Committee had recommended that a contract be entered into for the supply and delivery of four sets of plant, at £6939 per set, for the equipment of a new station in the neighbourhood of Green Lane. Mr. Rutherford raised a protest against the order on the ground that the Lighting Committee persisted in the system of manufacturing electrical power in retail fashion with small units of machinery. In New York a new power station had been built with 70,000-horse power. It was important that the Tramways Committee and manufacturers should get electricity at the lowest possible price. After further discussion, the Chairman of the Committee (Mr. Petrie) said that, as soon as they had the Pumpfields station and the Green Lane station, they would be able to supply electric power as cheaply as any town in the kingdom. Already with the small station in Paradise Street, from which they were supplying the trams, they proposed to do it at 9-10ths of a penny per unit. When the whole of the tramway system was completed, they would require 10,000-horse power, while for lighting purposes something like 25,000 to 30,000 horse power would be needed. What then was the use of going in for the heroic ideas of Mr. Rutherford? It was owing to the danger of fire, as had been shown in the case of Hamburg, that they were adopting the separate stations. The recommendation was agreed to.

The proposed electric lighting reserve fund was the subject of a report which the Hampstead Finance Committee presented to the Vestry last Thursday. They stated that they had considered a report from the Vestry Clerk, and found that the net profit on the undertaking from its

inauguration to Lady-day, 1898, was £2820 13s. 1½d., which does not include the aid received from the lighting-rate—an additional £1659 5s. 11d. After some discussion, the Vestry first decided that this latter sum should be recouped to the lighting-rate out of the electric light revenue account; Sir Henry Harben very ingenuously expressing his own "pious opinion" that the Committee ought to charge as much of the electricity expenses as they possibly could to the revenue account and not to capital, for "it would be better for the future interest of the Vestry." The Vestry then passed almost unanimously the following resolution: "That the whole of the net profits from time to time arising from the electric lighting undertaking be set aside to form a reserve fund until the same reaches 10 per cent. on the capital outlay; and that such profits be invested as and when the Finance Committee shall decide, and in such securities as the Vestry may from time to time think fit." After thus satisfactorily dealing with their prospective profits, the Vestry digested a volume of figures prepared by the Lighting Committee to prove that "the time had now arrived when it was necessary to make provision for the extension of the buildings at the central station, to enable the Vestry to cope with the probable increase in the demand for current which will be made upon them." They pointed out that at present there were 1145 consumers, 313 of whom were added during the first nine months of the present year—a largely increasing ratio. Having considered various alternative schemes, they recommended the erection of buildings capable of containing 4000 additional horse power. This would give about 2500 kilowatts capacity, and with the present plant would supply a total of about 248,000 8-candle lamps. The Vestry eventually authorized the Committee to prepare and lay before them plans of the proposed extensions. After such a decision, it was curious to find the Committee stating that "they had considered the question of the advisability of placing arc lamps in the business portion of Flask Walk, and were of opinion that it was not advisable to do so, but that it would be preferable to improve the gas lighting of that thoroughfare." So gas evidently has its uses, even in Hampstead.

At the meeting of the Court of Common Council of the City of London last Thursday, Mr. E. Lee presented a petition from the Charing Cross and Strand Electricity Supply Corporation, Limited, stating that they were desirous of supplying electrical energy within the whole of the City and its liberties, and duly made application for the assent of the Corporation to such powers being granted. The reasons for so doing were set forth in the memorial referred to in our "Electric Lighting Notes" last week. The petitioners had been informed that the Corporation found themselves unable to assent; but they asked that, notwithstanding such inability, the Corporation should cause the memorial to be put upon their records. Replying to questions by members, the petitioners said they would not be able to supply the public lamps cheaper than 2½d. per unit—the present rate. They wished to enter the City for the purpose of giving light to the signatories to the memorial and others. The desire to make a profit for their shareholders out of the City lighting incidentally entered into their calculations, as they did not claim to be philanthropists. Being asked if they knew that 7000 consumers now obtained their electric light from the existing monopoly, they said there would be 30,000 consumers if a healthy competition were permitted. They hoped to charge a maximum of from 4d. to 5d. per unit for private electric lighting, and from 2d. to 3d. for motive power. The memorialists and others were dissatisfied with the present price; and if the Company were permitted to undertake business in the City, they would accept any reasonable conditions which might be imposed on them. Mr. Lee moved that the memorial should be referred to the Streets Committee for consideration and report. Mr. A. C. Morton, in seconding the motion, characterized the petition as the most important one ever presented to the Court, and pointed out that none of its signatories were adventurers, speculators, or promoters of companies. They were dissatisfied with the present arrangements for electric lighting, as well as with the price. Within the previous five or six days, the whole circumstances connected with electric lighting in the City had changed. The verdict of the Jury in a recent libel action had rendered the Court free to give their consent to the admission of any other Company into the City, or even to undertake the electric lighting themselves. By clause 42 of the Sewers Act, 1848, it was enacted that no person, being a Commissioner or a member of the Courts of Aldermen or Common Council, should be directly or indirectly interested or concerned in any contract for the execution of any works, upon pain that every such contract should be null and void, and that the person who should be interested should forfeit £100. He had recently heard a member of the Court state on oath that he was directly interested in the existing lighting contract to the extent of £625. That being so, the contract was null and void: and the Court were perfectly free to do as they chose. The verdict of the Jury freed the City from the captivity imposed upon it in 1891. Mr. Brooke-Hitching said the Judge at the trial alluded to especially exonerated Sir Joseph Savory from any imputation of corruption. Mr. Morton (interrupting) said he never accused him. Mr. Brooke-Hitching said if it were possible to invalidate the existing contract, he hoped the electric lighting would be undertaken by the Corporation. To throw themselves into the arms of another Company would only make matters worse. Mr. Wallace said in 1882 the present Lord Mayor moved that the Corporation should undertake the electric lighting of the City. But Colonel Haywood, their Engineer at that time, strongly recommended them not to do so; and the Lord Mayor's motion was defeated by a majority of one. Mr. W. H. Pannell supported the proposition. He said the Commissioners of Sewers considered the matter for nine years, and, after deciding not to undertake the lighting themselves, advertised for contracts, which resulted in the present arrangement. It was all very well, eight or nine years afterwards, when the industry was greatly advanced, and experiments had cheapened the production, to criticize the Commission adversely; but he believed they acted honestly and according to their lights at the time. He advised them not to hold out any fresh inducements to electric lighting companies, but, if they could legally do so, to do the work themselves. If they were legally bound by the present contract, they could emancipate themselves in fourteen years without disbursing a penny. The motion was then put and carried unanimously.

The Public Lighting of Grays.—The Grays Urban District Council have withdrawn the notice given to the local Gas Company that they intended to terminate the present agreement on the 31st inst.

SALES OF STOCKS AND SHARES.

The sale conducted by Mr. Alfred Richards at the Auction Mart, Tokenhouse Yard, E.C., last Tuesday was not of such magnitude as the one noticed in the "Journal" last week. Acting upon the instructions of the Directors of the North Middlesex Gas Company, he offered for public competition 500 ordinary £10 shares in the undertaking. They ranked for a standard dividend of 7 per cent., subject to the sliding-scale; the last dividend on similar shares having been at this rate. The highest price realized per share was £16 12s. 6d.; the lowest, £15 10s.; the average being £15 14s. 2d.—yielding the purchaser £4 9s. 1d. per cent. per annum upon his investment. The total amount produced by the sale was £7855. Some fully-paid "B" £10 shares in the Bournemouth Gas and Water Company, entitled to 7 per cent. dividend (which has been paid for several years past), were sold at the following prices per share: Highest, £17 10s.; lowest, £17 5s.; average, £17 5s. 9d.—yielding £4 1s. per cent. on the investment. The sale of these shares produced £2265; and the total realized by the entire sale was £10,120. On the same day, £40,000 of new 7 per cent. stock of the Liverpool United Gaslight Company was offered for sale by auction by Messrs. Branch and Laete. It was put up in lots of the nominal amount of £100 each, and was disposed of at prices averaging £172 8s. 1d. each. Last Tuesday evening Mr. W. E. R. Randall publicly sold, at the Chatham Auction Mart, nine original £5 shares in the Brompton, Chatham, Gillingham, and Rochester Water Company, for £15 9s. each; three similar shares fetching £15 10s. per share. Last Wednesday, Mr. Morrison, auctioneer, Airdrie, offered for sale, on behalf of the Coatbridge Gas Company, in Coatbridge Lesser Town Hall, 500 new £10 shares of the Company, bearing dividend at the rate of 7 per cent. The upset price was £12 per share. One lot sold at £14 5s., 38 lots at £14 7s. 6d., and eleven lots at £14 8s. 6d. The average price per share was £14 8s. 2d. On Thursday afternoon, eight 4 per cent. preference shares of £10 each in the Maidstone Water Company were sold for £11 5s. per share; 23 original ordinary 10 per cent. shares of £10 each in the same Company realized £20 each; 15 ordinary 7 per cent. shares of £10 each fetched £16, and nine similar shares £15 apiece; while three others were sold for £15 10s. each. A hundred £20 5 per cent. "B" cumulative preference shares in the Farnham Water Company were disposed of by auction last Friday, and realized £2835 10s.

STOCKTON AND MIDDLESBROUGH WATER BOARD BILL.

At the Meeting of the Middlesbrough Town Council last Tuesday, attention was drawn to the Stockton and Middlesbrough Water Board Bill, by which powers are sought for the construction of Grassholme reservoir, in the valley of the Lune, Upper Teesdale, at a cost of £580,000, owing to the necessity of providing an additional water supply on Tees-side. The General Purposes Committee recommended that the Board proceed with the Bill, provided that they could obtain an increased price for the water from larger consumers, and that such increased price remain in force until the Corporation have been recouped their loss. On the adoption of the minutes being proposed, Mr. Matteson moved as an amendment that a price be named to the large consumers—viz., 5d. per 1000 gallons, instead of 3d., which is the rate at present charged them for water for manufacturing purposes. The amendment having been seconded, Alderman Bell, the Chairman of the Water Board, gave some statistics showing that the cost of the water undertaking was being gradually lessened year by year, and that, in the course of a few years, owing to the growth of the population and trade of the district, it would become a paying concern. The price to the large consumers of water was now very little above 3d. per 1000 gallons. He considered the three Corporations who owned the water undertaking (Stockton, Middlesbrough, and Thornaby) had two things to consider—first, their position as persons bound to do the best they could for the ratepayers, and, second, as persons bound to do the best they could for the district; and they would best fulfil these two obligations by consenting to the Bill passing into law with such moderate addition to the 3d. clause as would help the ratepayer through in time of difficulty, and permit the growth of the district to continue unimpaired in the future as it had proceeded in the past. The minutes were adopted.

The Bill is exercising very considerably the minds of the ratepayers in the districts of the Authorities composing the Water Board, seeing that the income of the undertaking does not balance the outgoings; and, consequently, inasmuch as the deficit has to come out of the rates, there is some objection to the Board entering upon the construction of new works under present circumstances. The argument of the Board, briefly stated, is this: The cost of every 1000 gallons of water supplied, including interest and redemption, is about 5d., and the revenue nearly 4d.; leaving a deficit of 1d. to be made up from the rates. But this calculation is based on the present supply. Were the delivery as much more as it is, the average outgoings per 1000 gallons would be 4d.; and thus income and expenditure would be equal. The Board evidently have the very best of reasons for believing (or knowing) they could sell more water; but under the circumstances of a rapidly growing district, 20 million gallons is too little a margin to work on. Thus they recommend fulfilling the obligations they definitely undertook to construct the Grassholme reservoir, and calculate that, by the time it is finished, the sale of water will have grown so considerably as to provide nearly as much more revenue as will suffice for the interest and redemption charges which they will then, and not till then, be called upon to pay. If at the same time they can get an increased rate from the ironmasters—½d. per 1000 gallons producing £6000 per year—this consummation becomes more easily assured.

Hull Corporation Gas Supply.—The subway which is to be constructed under the Queen's Dock basin at Hull for the pipes to convey gas from the mains of the British Gaslight Company into the gas-supply district of the Corporation will cost £3480. A tender to do the work for this sum has been accepted.

METROPOLITAN WATER SUPPLY COMMISSION.

Fortieth Day—Monday, Dec. 12.

(*Viscount* LLANDAFF, *Chairman*, *Sir* JOHN E. DORINGTON, Bart., M.P., *Sir* G. B. BRUCE, M.Inst.C.E., *Major-Gen.* A. DE COURCY SCOTT, R.E., *Rt. Hon.* J. W. MELLOR, Q.C., M.P., *Mr.* A. DE BOCK PORTER, C.B., Mr. H. W. CRIPPS, Q.C., *and Mr.* R. LEWIS.)

The Commission sat at the Guildhall, Westminster.

The following are the Counsel engaged: Mr. POPE, Q.C., and Mr. CLAUDE BAGGALLAY, Q.C., for the New River and the Southwark and Vauxhall Companies; Mr. LITTLER, Q.C., and Mr. LEWIS COWARD for the Kent Water Company; Mr. PEMBER, Q.C., for the Lambeth, East London, Grand Junction, and West Middlesex Water Companies; Mr. RICKARDS for the Chelsea Water Company; Lord ROBERT CECIL for the Hertfordshire County Council; Sir JOSEPH LEESE, Q.C., M.P., for the Kent County Council and Kent Local Authorities; Mr. BALFOUR BROWNE, Q.C., and Mr. FREEMAN, Q.C., for the London County Council; Sir R. NICHOLSON for the Middlesex County Council; and Mr. GABRIEL P. GOLDNEY (Remembrancer) for the Corporation of the City of London.

Mr. *R. E. Middleton*, further cross-examined by Mr. BALFOUR BROWNE, said the point of a table of rainfall at Greenwich which had been put in was that the rainfall during the last fifteen years was 22·25 inches; while for the previous eighteen years it was 26·03 inches, or 3·78 inches more. This amply accounted for any lowness of water there might have been in the Kent streams and water-courses. Witness agreed that to increase the supply from Staines for any given quantity would involve storage in far greater proportion than the first quantity involved; and in succeeding quantities the storage would be in much greater proportion. The question was, however, really one of supply. The Staines aqueduct was not being fenced, though witness had talked in Parliament about doing so, to prevent flood-water from the Thames getting into it. He could not say how many thousand acres of land in the Thames Valley were now under water. If many thousand were under water, he did not think a great deal of farm land manure would be brought down which would get into the aqueduct. He had the figures of various items in his estimates of the Staines scheme, but did not feel called upon to give them. At present the Water Companies paid to the Thames Conservancy about £25,450 per annum for the supply of 185½ million gallons daily. He dared say they would have to pay some £34,365 per annum when the quantity taken was increased. Therefore in comparing the two schemes —the Welsh and the Staines—it must always be remembered that a payment would have to be made to the Thames Conservancy which would not be necessary in the case of the Welsh water. His Welsh estimates were not made on any survey of the ground. In other water schemes, he naturally used surveys and levels if he had them, and checked them by analogy. The use of analogy was perfectly legitimate. In calculating the expense of bringing 123 million gallons daily from Wales, witness thought the cost of works in progress should be included. He agreed, however, that no part of the £7,000,000 he had allowed for this item was to be expended in obtaining this 123 million gallons. He had also included an item of £13,916,000 for accumulation of interest calculated to the year 1936. This was the year when the reservoir would be exhausted; it would then be supplying all the water it could. Against this sum, he had not put down a penny for receipts. If the interest until 1936 and the cost of works in progress were to be eliminated from the calculation, his estimate of £42,000,000 would be reduced to £21,000,000. But he did not see why this should be done. Witness was then cross-examined with a view to showing that the analogy afforded by the Birmingham supply and the supplies of Manchester and Liverpool were misleading; but he maintained that they afforded reliable data. The figures of these schemes included the cost of purchasing the watersheds.

Mr. BALFOUR BROWNE: There is not a penny in the Staines scheme for the purchase of one acre of the watershed?

Witness: We have had to pay a very large sum for the watershed by way of a rental to the Thames Conservancy for inspecting it, and preserving the water pure for the use of London.

Why, in your progressive Welsh estimates, do you include the Irfon reservoir?—Because it was included in Sir A. Binnie's report.

Do you know Sir A. Binnie has never suggested that it should be construed as part of the present scheme at all?—So I believe.

In answer to further questions, witness said he agreed that the total present supply from the Thames and other sources was a little over 202 million gallons daily, and that the quantity which would be required in 1931, according to Lord Balfour's report, would be 415 million gallons. In order to double the supply, the Companies would probably have to double their capital expenditure, which was over £16,000,000 in 1896. He did not think it was necessarily true that if droughts and frosts prevented a Company giving a proper supply, the Company were not in a position to earn their dividend.

The CHAIRMAN remarked that it had been the contention of the Companies all through that if frost or drought occurred, they need not supply any water at all.

Witness said a corporation were surely in exactly the same position as a company. They were just as liable to make default; and there could be no doubt the ratepayers would have to pay under the circumstances. Among the matters giving a prospect of increase of income, was the quinquennial valuation; but against this must be set the increased consumption per head of the population—supposing there were any. He did not think there would be any such increase per head. The Companies had an adequate supply of water—even having regard to what had happened this year—but they had not the means of dealing with it. If they carried out the enormous scheme of eventually supplying 400 million gallons a day to the Metropolis, he should think the sinking fund clause would be done away with, and the Companies would have to raise the money by giving persons subscribing a profit. As to whether the money for the Welsh scheme could not be raised at a cheaper rate by the County Council, he believed there would be little, if any, difference.

Mr. *Walter Hunter*, Engineering Director of the Grand Junction Water-Works Company and Joint Engineer to the Staines Reservoirs Joint Committee, examined by the CHAIRMAN, said whether the Companies were purchased or not, the Staines scheme, with the added Thames supply, must be adopted, or water must be obtained from Wales. The Staines scheme would be much the less costly. Originally, in conformity with a suggestion from the Local Government Board, it was held that no flood-water should be impounded for the first fifteen days; but subsequent reflection and discussion had led him to the opinion that no arbitrary line should be laid down—that the time of such pumping should be left to the engineers in charge, who would always be unwilling to take flood-water unnecessarily, owing to the additional work it would throw on the filters. Witness was fortified in this opinion by experience at the Grand Junction Water-Works at Hampton, where, by using a 45-million gallon storage reservoir as a subsiding reservoir, and drawing off the water from the surface instead of from the bottom, the work of the filters had been so lightened that they had gone much longer than was previously possible without the necessity of cleansing them. The rejection of the first two days of any flood would be quite sufficient to cleanse the surface of the land and wash out the ditches; but even this restriction was rather a precaution than a necessity. He, however, allowed six days in his calculations. Sir E. Frankland, Sir W. Crookes, and Professor Dewar were also of opinion that no advantage was gained by the rejection of flood-water. Witness held that, for the protection of the river and the equalization of its flow, it was desirable that as much water as possible should be taken from it in periods of flood. Even during the drought of the past summer the quality of the water had not fallen off. With regard to the minimum of 200 million gallons daily at Teddington Weir, witness said he took it originally as the basis of his calculations because it was the limit fixed by the Thames Conservancy in their instructions to Messrs. Marten and Rofe for the storage scheme in the Upper Thames Valley. He had never, however, seen any logical grounds for fixing a limit, and none was fixed by Lord Balfour's Commission. Sir A. Binnie wished it to be 250 million gallons daily, and the Thames Conservancy 200. When 200 million gallons were flowing over Teddington Weir in 24 hours, or 100 million gallons per tide, 1480 million gallons were flowing at Putney on the ebb of an ordinary tide. The difference between the Conservancy figures and those of Sir A. Binnie at Putney would therefore be only 1·65 per cent.; and at London Bridge, only 0·6 per cent. Similarly, if only 100 million gallons were flowing at Teddington in 24 hours, the diminution in the tide at Putney would be 3·4 per cent.; and at London Bridge, 1·2 per cent. A reduction of 100 million gallons at Teddington made a very small difference in the bulk of water running through London Bridge; the scour being mainly effected when the river was running in flood. The doing away with old London Bridge had a great effect on the flow of the river, causing a sudden fall in the low-water line of from 5 to 6 feet; and the high-water line rose by the water being heaped up. The Thames Embankment had also increased the scour of the river very largely. No harm was done, and no inconvenience felt or expressed, when, on July 28, 1896, the flow at Teddington fell to about 108 million gallons; and in the present exceptional year, when the rainfall for the twelve months ended Sept. 30 had been less than for 82 years—the total from Jan. 1 to Sept. 30, being only 44·5 per cent. of the average—not the slightest inconvenience was felt, and hardly a complaint was made to the Thames Conservancy as to the quantity of water in the river. This was not to be wondered at, seeing that above Teddington Lock the abstraction of all the water coming down the river, with the exception of that required for lockage (about 3 million gallons daily), would cause no difference in the appearance and navigability of the river. Below Teddington, the channel was filled to high-water line twice every 24 hours by the tidal wave. As the average flow at Teddington of only 76·98 million gallons in September, with a minimum of 42·3 million gallons on Sept. 13, had caused scarcely a single complaint, obviously if the average flow were raised by 30 per cent., and the minimum flow by 136 per cent., the condition of the river must have improved. The drought of this year showed that a limit at Teddington of 200 million gallons daily was much too high. When the storage proposed was completed, the Companies would not deplete the river below 100 million gallons; but if the natural flow was below this figure, the Companies would not make the deficiency good. Witness's estimates of the Staines scheme were practically on the same basis as Mr. Middleton's; but they varied slightly in detail. Witness had taken out the figures a little differently. Like Mr. Middleton, he used the figures of actual contracts for work now in hand, *plus* 10 per cent. for contingencies. He had calculated on a flow at Teddington of 100 million gallons daily. On this basis, witness brought out that for an average daily supply of 130 million gallons, on the conditions of 1898, a storage of 920 million gallons would be required, against 8314 million gallons according to the calculation of Mr. Middleton; the latter reckoning on a flow of 200 million gallons at Teddington.

The CHAIRMAN: That makes your point of the 100 million gallons at Teddington one of the gravest importance?

Witness: It is, I quite agree. That is why I venture to say that the questions relating to the bodies supplying the water are side-issues; but that upon the proper solution of the question as to the minimum flow at Teddington depends the economical user of the magnificent natural water supply which the position of London, on the banks of a river with the largest watershed in England, should secure to its inhabitants.

In answer to further questions, witness said to supply 300 million gallons a day, on the conditions of 1898, he calculated would require 17,300 million gallons storage; but according to Mr. Middleton 30,468 million gallons storage would be necessary. In the same way, witness made the total storage required to supply 400 million gallons daily, 31,243 million gallons. He handed in a table showing the number of days on which the river would be drawn below a flow of 200 million gallons, with a supply first of 307 million gallons and then of 400 million gallons daily; the storage being fixed on the basis of a minimum flow at Teddington of 100 million gallons. The table went back to 1883; and it showed that in many years there would be no occasion to so draw the river down, while in others the occasions would be very few. The reservoirs already authorized would be sufficient, with a minimum flow of 100 million gallons at Teddington, until the year 1920—giving a supply of a little over 200 million gallons daily. His limit of 100 million gallons at Teddington would only apply when the 6176 million gallons of authorized storage were completed. As soon as this storage was provided,

the necessary supplies for London till 1948 could be given by the gradual construction of reservoirs, always leaving 100 million gallons flowing at Teddington. Witness handed in further elaborate tables giving his estimate of the daily supply of 121½ million gallons (beyond the 185½ million gallons already authorized) from the Thames; the total figure being £8,035,254. For a further supply of 93 million gallons (making a total of 400 million gallons), the figure was £7,463,857. These estimates were less than those of Mr. Middleton; the difference being chiefly due to the fact that witness had adopted the 100 million gallons limit, which meant the provision of less storage. He confirmed Mr. Middleton's calculation as to the cost of the Welsh scheme; agreeing that the estimate by analogy was reliable and sound. The total estimated cost of the Welsh scheme would be £37,169,165; and of the Thames scheme (under the conditions of 1898, with a minimum flow of 100 million gallons at Teddington, and to supply 214 million gallons daily beyond the 185½ million gallons already authorized), £15,499,111.

Forty-First Day.—Dec. 13.

All the Commissioners were present except Mr. Cripps.

Mr. *Hunter* attended for further examination.

The CHAIRMAN: I gather, from tables you have already put in, that you think the Welsh scheme is not in the least needed at present?

Witness: That is so.

Mr. DE BOCK PORTER: Do you think it would be desirable to take any steps to secure the area?

Witness: I think it might be desirable in the interests of London to secure an area, supposing that it may hereafter be wanted.

Then you are not of opinion that it will never be wanted under any circumstances?—That is very difficult to answer. It depends on the real growth of London. Some people think that London will not increase in the future as it has in the past; and therefore that the Welsh scheme will never be wanted at all. The view I have taken generally with regard to the utilization of the Thames or bringing water from a distant watershed, may be summed up generally in this way: We have a river at our feet which at any rate has an average flow of something like 1300 million gallons a day. It is suggested that we should go to Wales and open up a supply from an area or watershed which at most, according to evidence, will be able to afford 415 million gallons a day. The promoters of the scheme proposed to abandon the Thames and the Lea altogether. What would happen would be that the 415 million gallons a day would be used up within a certain definite period; and then, having incurred all the expense of bringing the water from Wales or elsewhere, they would have to go back to the Thames. I have always felt that it is a question of expense between the two schemes. If the Thames can be developed and give water at a less expense than the Welsh scheme, it is absurd to go to a distant watershed until you are compelled.

The CHAIRMAN: But if you put it off too long, you may lose your area altogether?

Witness: That is so.

In reply to Mr. DE BOCK PORTER, who asked whether his proposal as to the 100 million gallon limit was likely to commend itself to the Thames Conservancy, witness said that save in exceptional years the limit would be sufficient for the river; but what the views of the Thames Conservancy might be, he could not say. The position of the Lea was not an ideal one; and he should not like to see water pumped back into the Thames as had been done in the Lea.

By the CHAIRMAN: If a rule were made that the limit should be 200 million gallons at Teddington, capable of suspension by some Government official in case of emergency, it would rather lie with the Companies to show it was necessary to go below this figure. Taking into consideration interest and sinking fund charges, the additional annual cost of the Welsh scheme, as compared with the Thames scheme, for the same quantities of daily supply, would be: From 1920 to 1936, £520,165; from 1936 to 1980, £700,201; and from 1980 to 1996, £180,036. The Directors of Water Companies were to a large extent a permanent body, and therefore gained a valuable insight into matters connected with waterworks and their economical administration. As to whether such a body as the London County Council were likely to administer the undertakings well, he said necessarily with such a body the Committees were more ephemeral and were larger than Boards of Directors, and therefore not so efficient. With a large Board, they had not that rigid inquiry into everything that they had with a smaller body. With regard to the variation of rates over London, witness thought Parliament had wisely exercised its judgment. He agreed that if the undertakings were all in one hand the charge could be averaged; but those who were paying the lower rates would grumble very much if this were done. A capitation charge for water, if it could be levied, would be the fairest method; but as this was impracticable, the only way was to put a higher charge on the rateable value of a house in one district than in another, because the number of persons inhabiting a house would be larger in one district than the number inhabiting a house of similar rateable value in another. This should be considered in settling the matter. Rateable value, though clumsy, was the most practical method of levying the charge. Whether or not the Companies would like to supply by meter, depended on the price they obtained. The fairest way of charging would be a rate, with a meter-charge above a certain amount, so as to make each consumer his own waste inspector. He was clearly and strongly of opinion that the supply from the Thames would be the most economical for the next fifty years, in that it could, and would, be carried out by instalments if and when actually required.

Cross-examined by BALFOUR BROWNE: If any supply beyond the Thames were sought, that from Wales would be the best. So far as his experience went, the Companies were always ready to spend whatever money was needed for the protection of the consumers. His estimate of the Welsh scheme, like Mr. Middleton's, was based on the analogy of the Manchester, Liverpool, and Birmingham schemes; and he thought it was in no way exaggerated. His tables also assumed that the Welsh expenditure would have to be repaid in sixty years. He was not aware that this was a shorter period than the County Council proposed.

Sir *Frederick Bramwell*, Bart., in reply to the CHAIRMAN, said he had for many years been consulted about works in connection with the problem of water supply. The consumers of water and the ratepayers might be taken as practically identical. As regarded non-domestic supplies, there were very many large undertakings where the owners had private sources. As long as the Companies continued in existence, it seemed that there could not possibly be a rate-in-aid; but if a municipal authority managed the concerns, there might be one, which would fall very heavily on these business undertakings.

The CHAIRMAN: You know the subject committed to us—viz., whether purchase by any one or more authorities is financially expedient. Would you kindly give us the result of your judgment in the matter?

Witness: My opinion is that it is not expedient that the Companies should be acquired, either in the interests of the water consumers, or, in so far as they are separate, in those of the ratepayers. I assume that they could not be acquired without the purchasing authority or authorities paying for them such a sum as would represent the profit income they now derive. Anything else, it appears to me, would be unfair to the persons who originally embarked their money under the parliamentary sanction and guarantee of the income—if it could be earned—and to those who subsequently bought shares at enhanced prices due to the increase in the value of money. I presume, therefore, they would have to pay the full value. If this be done, and taking into account the sinking fund, it seems to be perfectly certain that the purchasing authority could not afford to make a less charge for water than is made now. Therefore, there is no saving to the consumer. As regards the ratepayer getting any profit out of the transaction, I think it extremely problematical, because, as I say, the full value would have to be paid. I do not see where the economy is to come from, if, in extensions, the Companies can, under the sanction of the Auction Clauses Act, raise their money by debentures as cheaply as the others; and there is no sinking fund to be paid except the particular one I may have to talk of hereafter. If it be under the notion that there will be economy in management, I do not believe it. I do not see where the economy is to come in. London is so vast that the eight Companies do not appear to be in any way in excess of the management needed. The officials, if the Companies were purchased, would be equally numerous; and they would have to be equally well paid. There might be a saving in Directors' fees. This, however, would be more than counterbalanced by the compensation to be paid the Directors, besides which there would have to be officials appointed as heads of departments.

In further examination witness said that the interest on the capital necessary to purchase the undertakings, and the payment to be made for sinking fund, would absorb all the profits which would be made out of the sale of water. No reduction of rates would be possible. If the income grew, it would only be on account of new capital expended. No municipal body would raise capital at a much lower rate than the Companies. He was not at all sure that in other cases of water-works purchase reduction of rates had followed. He was consulted about a rate-in-aid at Liverpool; and he thought there was one at Manchester. He would not, however, say that in a number of instances the water charge and rate-in-aid did not form a reduction on the old price. He doubted very much whether a public authority would be more efficient in preventing waste than were the Companies; and, in support of this opinion, he referred at length to instances which had come under his knowledge in America. As to what ought to satisfy all reasonable requirements per head for such a city as London, he put the figure before Lord Balfour's Commission at 20 gallons for domestic and 6 gallons for manufacturing purposes; but owing largely to the increase of baths in houses of comparatively low value, he accepted the figure of 35 gallons, which he thought ample. Witness had acted for Bradford, where Sir A. Binnie came from, in respect of several of their Bills. In that town, failure appeared to be perennial; and he quoted from an issue of July last of the "JOURNAL," in which the possibility of the town being put on short supply was foreshadowed.

Mr. DE BOCK PORTER: Would you say that this is the result of municipalization?

Witness: I think so. If the water undertaking had been in the hands of a Company bound to keep up the supply, they would have done it. I should not say the condition of East London was worse during this year than that of any municipality.

By the CHAIRMAN: He thought what happened in East London was not to be wondered at, if the way in which the Company had been treated was considered. He referred to the fact that when the Company went with a Bill in 1893, Parliament would not even let them go to a Committee to say whether or not their statement that they required more storage was correct. He called that bad treatment. It was extremely undesirable that the control of water should be in the hands of a fluctuating body, because with such a body they could not get unity of purpose, as with a continuing one. To split the undertakings among the various authorities would be confusion worse confounded. With regard to giving every county its own water supply, witness asked where the division was to stop. Why not give Islington, with its 300,000 inhabitants, its own supply, and treat the other parishes and localities similarly? He doubted the contention of the counties that they had ample water at home. The body of all others to which he would not give control of the concerns was the London County Council, because of their avowed disbelief in the propriety of the present supply. He did not even believe in the sudden conversion of this body to regarding the Thames as a supplemental source. Further, the business of the Companies was so vast that it ought to be confided to a body having nothing else to do, and not to one already overburdened with work—a body not subject to periodical change by election, and having its conduct influenced thereby. The quality of the Thames water was perfect. He was not prepared to give detailed evidence of the Staines scheme; but, speaking broadly, he entirely approved it as being sufficient. From an engineering point of view, the circumstances were most favourable. If necessity arose, the Companies ought to be allowed to take all the water at Teddington except what was required for navigation, rather than incur all this extra expense for the mere purpose of having ornamental water—for it was nothing more—going over the weir. He was not sure whether it would be an improvement or not for the eight Companies to be fused into one. To his mind, London was so large that the eight managements were entirely justified. Witness was then examined at some length as to whether, if the Companies were purchased and managed by a body of experts specially for the benefit of the consumers, financial advantage would not result to the latter. He did not see why it should. The purchasing body would only deal with extensions; and he did not see that

they could possibly do so more economically, or any more in the interest of the consumers, than the Companies did at present. The Companies managed their business better than experts would. All possibility of future profit would have to be paid for by the purchaser. He had no doubt an arbitrator would allow for profit on capital not yet raised, if it could be shown that it would yield a profit. He did not think the impression that the Companies did not come up to the standard of their duties was well founded. Even in the case of the East London Company, there had been no lack of foresight in the extension of their works. With regard to the imposition of the sinking fund, he found it difficult to speak without temper. It was a contrivance by which, when a Company were trying to raise money for something that was needed, a heavy fine was put upon them—a fine which, if he was right, in the case of the New River Company would cause money to be raised at 8 per cent. instead of 3 per cent. The extra amount to be earned, and which was to go into the sinking fund, was only to be earned at the expense of the dividend on the existing capital; and this he called an instance of parliamentary bad faith.

Mr. De Bock Porter: The effect of the clause has been that it will moderate the price of the undertakings if purchased?

Witness: I have no doubt that is the case, because it reduces the dividend on the existing shares.

Mr. Lewis: The great objection is that when a Company raises capital for any purpose—whether it is to be productive or otherwise—Parliament steps in and punishes the existing dividend?

Witness: That is precisely it.

In further examination by the Chairman, witness expressed the opinion that the control provided by existing enactments was ample.

Witness having been briefly cross-examined by Mr. Freeman, on behalf of the London County Council, the Committee adjourned.

The forty-second sitting of the Commission was held yesterday, at the Guildhall, Westminster—Lord Llandaff presiding. Mr. Charles Hawksley was called, and, in replying to the Chairman, gave evidence regarding the future requirements of London, based on the rate of increase of population adopted in the report of Lord Balfour's Commission, and assuming the consumption to be 35 gallons per head daily, though he thought this quantity might be excessive. The growth of population, so far as it had been ascertained since 1891, showed that the estimate of Lord Balfour's Commission of the rate of growth of population was a perfectly safe one.

THE DERWENT WATER SCHEMES.

The Sheffield Corporation met last Wednesday to consider the various Bills of which notices have been given, relating to the schemes of water supply from the Derwent Valley. In the first place, a resolution was passed declaring that it was expedient for the Corporation to promote their own Bill; and two others asserted that it was similarly expedient to oppose the Leicester and Derby Bills. Alluding to the Derby Bill, Alderman Gainsford remarked that the opposition to this measure did not stand on quite the same footing as in the other case. The Sheffield Corporation would be prepared to entertain proposals and make arrangements for the supply of a proper quantity of water to Derby and the rest of the Derwent Valley, because it was obvious that they had a right to a supply of water from the area. The Derby Bill, however, proposed to take the whole of the area; and therefore Sheffield must oppose it. If it was a question of administering the area, Sheffield—both from proximity, size, and other considerations—was a more proper body to do so than the small Corporation of Derby. Further he claimed that the Sheffield scheme had merits which made it highly superior to that of Derby. On these grounds it was necessary that the Derby Bill should be opposed; but the opposition differed from the completer opposition to the Leicester Bill. Alderman Eaton considered it important that the Corporation should deal with this matter in a liberal spirit. It would be a mistake for Sheffield to go in entire opposition to Derby acquiring the right of water supply from the Derwent Valley. Alderman Gainsford endorsed this sentiment.

On the same day the Derby Town Council had their own scheme introduced to them by Alderman Bemrose, who moved the adoption of a report on the subject. He said that, generally speaking, the Council had made up their mind that an increased supply of water was wanted, and that they meant to obtain it from North Derbyshire. They found that Sheffield and Leicester were hankering after the same waters. It was quite true that Sheffield was not in Derbyshire, but still the Sheffield people seemed to have the spirit of annexation; and as some of the water trickled from Yorkshire into Derbyshire, they urged that they were entitled to it. At the same time Sheffield admitted that they had water sufficient for 25 or 30 years, and that they were also now constructing a large reservoir. Leicester undoubtedly was in the watershed of the Derwent and the Trent; and, therefore, Leicester might be considered to be more in the running than Sheffield. But the Committee, in weighing the matter over, came to the conclusion that the authority having the first claim to the waters was the town and county of Derby. It might be said that Derby did not want all the water. That was quite true; and thus the question came up of a Joint Board. To this, however, there were serious objections; and he did not think that they would be able to agree at all on such a Board. Leicester claimed that they were a larger borough than Derby. This was true; but it did not always follow that size was a gauge of capability, either of individuals, communities, or corporations. They (Derby) claimed that they had so far administered the water-works in a very proper and profitable manner to the town. During the past twenty years, they had spent £49,000 on capital account, and had had a supply of excellent water. Leicester were depending upon receiving £15,000 a year from Derby. If they assumed in the first instance that there must be reservoirs sufficient for 12 million gallons of water per day (it was estimated that the whole yield of the watershed would be 30 million gallons), the cost would be £1,200,000. Taking the cost for Derby at an excessive rate—say at £750,000—and the fact that they were not bound to make provision for a sinking fund for ten years, that the interest on capital expenditure had to be added with the capital after these ten years, that the term allowed for the repayment of the loan was sixty years reckoned from the expiration of the first ten years, and that the profits were to be funded for ten years, the result would be that the capital expenditure, with compound interest at the rate of 3½ per cent. per annum, would be, at the end of ten years, £912,000. He went on to show that, by the accumulation of the net profits, the aid of the reserve fund, and the natural growth of the revenue of the undertaking, it might be safely reckoned that the scheme would not necessitate a call upon the rates. Alderman Newbold seconded the motion, which was carried.

THE PURCHASE OF PRIVATE WATER-WORKS IN NEW YORK.

We learn from the "Engineering Record" that the New York Legislature have passed an Act authorizing towns "to purchase the works, property, and franchises" of any companies supplying them with water. It forms Chapter 554 of the Laws of 1898, and is as follows:—

1.—Any town in this State which has a contract with a water-works company for supplying such town, or any portion thereof, with water, may acquire the works, franchises, and property of such water-works company in the following manner.

2.—Upon the written petition of not less than one-tenth in number of the taxpayers of such town, who shall be assessed for at least one-tenth of the total amount of the property assessed in that town, the supervisor of the town shall ascertain the price which the water-works company will accept for its works, franchises, and property, and shall submit to the lawful voters of such town at the next town meeting the question whether such works, franchises, and property shall be purchased at the price specified as aforesaid.

3.—Notice that such question will be so submitted to the voters of the town shall be given by publishing the same once a week, for at least four weeks, immediately preceding the election, in every newspaper published in the town, and by posting a copy of such notice conspicuously in the office of the Town Clerk at least 30 days prior to the day of voting; and the Clerk shall see that such notice is so published and posted.

4.—At such election, each qualified voter shall be given an opportunity to vote either for or against such proposed purchase. If a majority of the votes cast on the question shall be for making the proposed purchase, the supervisor of the town shall forthwith make and enter into a contract with such water company for the transfer of the company's works, franchises, and property to the town. The town officers are hereby authorized and empowered to enter into such contracts and to bind their respective towns thereby; and such companies are authorized and empowered to make such contracts and to do whatever is necessary to fulfil them.

5.—At the time of making such contract, the water-works company shall make and deliver to the officers of the town a full, true, and accurate statement in detail of all its debts, contracts, obligations, and responsibilities of every sort; and such statement shall be verified by the President or Treasurer of the company. The amount of such liabilities shall be carefully estimated by the officers acting on behalf of the town, and the gross amount thereof shall be deducted from the purchase price named. Should there be any difference between the town officers and the company as to the amount of such liabilities, the same shall be referred by them to the County Judge of the county, and be decided by him.

6.—As soon as the amount of the company's liabilities has been thus ascertained and deducted, and the net amount remaining to be paid for the company's works, property, and franchises has been thus determined, the Town Board of the town shall proceed to raise the money and carry out, on behalf of the town, the contract so made.

7.—Such Town Board shall make and issue bonds of the town for the entire amount of the purchase price of the property, works, and franchises to be purchased as agreed upon and voted for as aforesaid. Such bonds shall run for not more than 30 years, and shall bear interest at a rate not exceeding 5 per centum per annum, and shall be a valid and binding obligation upon the town on behalf of which they shall be issued. They may contain such provision as to payment of a part of those issued at such times, short of the full term for which they might run, as in the judgment of the Town Board issuing them would be advantageous to the town bound thereby.

8.—The Town Board shall proceed to sell such bonds, at either public or private sale, for the best price obtainable, not less than par. Out of the proceeds of such sale, the Board shall pay to the water-works company that portion of the purchase price, agreed on and voted for as aforesaid, which remains due to the company, after making the deductions mentioned in the fifth section of this Act, upon receiving an assignment or transfer of all the works, property, and franchises of the company, duly executed by the company or by the proper officers thereof, in its name and behalf. The balance of the proceeds of such bonds shall be used as far as and when necessary to discharge the debts, liabilities, and obligations of the water-works company.

9.—Before naming the price for the property, franchises, and works of any company under this Act, as contemplated in the second section, the officers thereof must obtain authority so to do from a majority in number and amount of the stockholders. Such consent shall be given in writing, and be duly signed and acknowledged by the stockholders.

10.—Upon making such transfer and conveyance to the town, the debts, liabilities, and obligations of the company, which have been included in the statement referred to in the fifth section of this Act, shall become a charge upon the town, and may be enforced against it. And if the company should be called upon to pay any claim, or to do any act on or on account of such debts, liabilities, or obligations, it may enforce the same against the town.

11.—The works, franchises, and property purchased shall be managed and controlled for and on behalf of such town by the Town Board which purchased the same, and their respective successors in office

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The New Water Scheme for Ledbury.—The money required for the new water supply for Ledbury (£5500) was the subject of an inquiry by Colonel W. L. Coke, of the Local Government Board, last Tuesday. The principal witness was the Engineer (Mr. R. E. W. Berrington); and his outline of the scheme showed that duplicate engines were to be erected at a new well, and the water pumped to a reservoir at the Cross Hands to hold 75,000 gallons. Thence it would pass by gravitation into the old reservoir, which has a capacity of 99,000 gallons.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

An extraordinary case of an incorrect gas-meter has come to light in the Sheriff Court at Perth, where the Bridge of Earn Gas Company sued Mr. Dunbar, of Earnbank, for £26 odd as the price of gas which they said they supplied to him through a meter. Mr. Dunbar is Assistant Under Secretary for Scotland; and he first occupied Earnbank in 1895. In that year he and his household resided there for a period of nearly five months. During these months, Mr. Dunbar consumed 5000 cubic feet of gas, for which he paid the Company nearly £2. In 1896, Mr. Dunbar and his household resided at Earnbank for a little over six months; but the Company's bill for the gas consumed in that time amounted to over £26—the quantity charged for being 80,200 cubic feet. Mr. Dunbar was satisfied that so much gas could not possibly have been consumed. He, however, offered to pay for 21,000 cubic feet, or, if the Company preferred it, to allow the matter to stand over until the quantity of gas consumed at Earnbank in 1897 was ascertained. The Company, who had had the meter tested in the usual way, declined to accept either of Mr. Dunbar's offers, and took out a summons against him. They also cut off his gas supply. Accordingly, Mr. Dunbar, in his own interests, as well as in those of the gas consumers, resolved to defend the case. In the proof that was led, the Gas Company relied entirely on the test which they had had made; while the defender's evidence was to the effect that the gas consumed at Earnbank could only have been proportionately the same in 1896 as in 1895. Sheriff Grahame, before whom the proof was led, thereafter remitted the meter to Mr. John Jack, Inspector of Meters, of Edinburgh. Mr. Jack was requested to report upon the character of the meter, and its efficiency as a trustworthy instrument for measuring the quantity of gas passing through it. In his report, Mr. Jack stated that the meter had a reverse action—that is, instead of 10,000 it would register 90,000, and so on till it became a jumble; and that the correct reading of the index should have been 13,800 instead of 80,200 cubic feet—the overcharge on the total being 71,400 cubic feet. This entirely corroborated the evidence which Mr. Dunbar had led. The Company consequently abandoned the action, and have now paid Mr. Dunbar's expenses. Can anyone explain what this reverse action can be? To me it is a mystery. It could scarcely have been caused by faulty construction of the meter, because it would have surely been discovered at the first testing. Then it must have been an intermittent action, or it would have been detected at the testing after Mr. Dunbar challenged the meter. Could it have been the result of the action of some one tampering with the mechanism? The Company have acted very fairly in the matter, in the end, by withdrawing their action. It is a pity they did not display the same spirit of fairness earlier. In a case which was manifestly one for inquiry, and in which they had so handsome an offer, it seems to me that they were not justified in cutting off the gas supply.

The want of stopcocks upon the gas-services in Glasgow was the subject of comment in the Glasgow Town Council on Thursday. It was introduced by Bailie Battersby, who asked to what extent the Gas Department had the power, in the case of fires, to turn off the gas. He understood that there were no stopcocks; and he asked the Convener of the Gas Committee to take the matter into consideration. Mr. R. M. Mitchell, the Convener, said he thought that a Sub-Committee had been appointed in connection with this matter; but, if not, he would be happy to take up the subject. Now, to put stopcocks upon every service-pipe in Glasgow is so gigantic a work as to make it almost impossible. There are about 180,000 consumers supplied with gas by the Corporation.

The Monifieth Police Commissioners are a youthful body; the burgh having been created only a year or two; and it seems they have not yet got into the way of conducting public business. As is known, the community, by what is generally looked upon as a catch-vote, rejected the Burghs Gas Supply Act after it had been adopted. Following this, a Gas Company was started, with Provost Stewart at the head; and the Corporation have entered into an agreement with the Company for the lighting of the streets. This agreement is loathed by the party who were instrumental in preventing the erection of a corporation gas-works; and they have made several attempts to have it set aside. The last was on Tuesday, when a motion was made by a Mr. Anderson that they refuse, in the meantime, to recognize the agreement which was made by the last Commissioners as binding upon them; and that the opinion of a legal gentleman of standing, who had no connection with the burgh, should be taken as to their future action. Bailie Robertson, who was in the chair, ruled the motion to be incompetent. He would have acted wrongly if he had done otherwise. The agreement is binding upon the Commissioners for the time for which it provides, and can only be set aside by mutual consent. There is a doctrine that members of a corporation cannot bind their successors; and it would almost seem that this was what the opposition stumbled upon, as they attempted to set up a distinction between the Commission which existed before the last election and the present one. Of course, this was an erroneous view to take; and the Chairman pointed out the mistake. The doctrine is one which cannot be applied generally. As a matter of fact, every corporation does each year bind its successors in regard to contracts entered into; and to admit the possibility of a commission having power to overturn contracts which may be distasteful to new members would be to introduce confusion into public business.

The Town Council of Aberdeen on Wednesday made their annual inspection of the gas and electricity works. Lord Provost Fleming switched on the electric current to the west-end of the city, the supply of which is to be obtained from a 650-horse power steam-engine which has just been put in. At the close of the inspection, a light luncheon was partaken of; and one or two toasts were drunk. The speaking to these was of the customary congratulatory order, for which there is room, so far as regards the gas-works at least, the condition of which is in reality second to none. There was a remark which struck me, made by Mr. A. Smith, the Gas Engineer, who said that he had been at the works now for a long time, and that he thought he was eligible for a pension. The statement was received with laughter, as if to the Corporation the idea of the undertaking being carried on without Mr. Smith's supervision was too ludicrous to be entertained. In all probability Mr. Smith spoke in jest; but coming events do sometimes cast their shadows before them, and it is not beyond possibility that he may be beginning to entertain ideas of taking things more easily.

Mr. S. Stewart, the Engineer and Manager of the Greenock Corporation Gas Department, presided at the annual social meeting of the gas-works employees this week, and gave an address upon the growth of the gas business in the town. The works, he said, were opened seventy years ago. In the first year, 3,200,000 cubic feet of gas were consumed, at a cost of 12s. 6d. per 1000 cubic feet. The make this year would be about 270,000,000 cubic feet, with 11,500 customers; the price being 2s. 11d. per 1000 cubic feet. The demand had increased twofold since Mr. Stewart became Manager; and he saw no reason why the annual increase should not continue. Though the Police Board were introducing the electric light, he did not anticipate that it would affect the annual demand for gas. On account of the continued progress of the undertaking, Mr. Stewart has reported upon the necessity for an extension of the works. These, he states, were designed for a maximum make of 300 million cubic feet per annum, and the production now nearly equals this amount; so that it has become a necessity to prepare for an extension, especially in the carbonizing department. The proposed extension has been estimated to cost £30,000. The subject will come up for consideration shortly.

A fatal case of suffocation by gas occurred in Stirling on the morning of Saturday last, when a female servant was found dead in bed. The occurrence did not take place on account of any defect in the gas-fittings, but because the gas was found to be turned full on. What led to its being so, is not explained.

The owners of lime-works in the Lothians have resolved that, in consequence of the increased cost of labour and fuel, the price of lime is to be advanced by 1s. a ton; the increase to take effect as from the 15th inst.

Somewhere about the beginning of 1884, I think, the Corporation of Arbroath were greatly exercised over the town's water supply, which was then being pumped from a well at Nolt Loan. A report on the general question of water supply was obtained from Mr. G. Wilson, of Edinburgh, which was altogether in favour of a gravitation scheme. Mr. Wilson's report was thrown over; and the Corporation resolved to sink another well, at Warslap, to catch the same underground flow of water, which is supposed by some to exist in great quantity. The well was sunk, and it proved disappointing. It was then resolved to excavate adits to the east and west of the new well. This work has been proceeding, with sundry hitches, for nearly two years. Some 500 yards of adit were to be driven; but in the contract there was a saving clause to the effect that 1000 yards should be driven east and west respectively, on the completion of which the Commissioners would meet and consider what further steps they would then take. Some 300 yards having been driven each way, a fortnight's meter test was agreed upon. This having been completed, the Sub-Committee who were appointed to take the readings of the meter met, and drew up the result of their findings. These readings were communicated to the whole Board sitting as a Committee, when the yield was, for the last nine days of the test, stated to amount to 276,000 gallons per day, or 11½ gallons per day per head of the population. After considerable discussion, it was decided that the adit should be continued eastward to the extent of 300 yards. This recommendation recently came before the Police Commissioners, and was adopted. In the minority was Provost Grant, who declared himself in favour of Mr. Wilson's scheme being again considered; and after the vote was taken, three of the Commissioners recorded their dissent, on the ground that, in their opinion, the further prosecution of the adit scheme would result in useless expenditure. I entirely agree with the minority. The adits, so far as constructed, have raised the supply from the well from about 7 to nearly 12 gallons per head of the population per day. Proportionally, other 300 yards of adit will increase it from 12 to 21 gallons, which is altogether inadequate, according to modern requirements; and there is this further to be considered, that as it approaches the old Nolt Loan well, the adit will draw off water which should flow into it, and any increase in the Warslap well will consequently be at the expense of the Nolt Loan well. The cost of a gravitation supply would be more than the well scheme; but, as it is almost inevitable, looking to the future, it will be matter for regret if large sums should be spent upon the wells and pumping plant, to be afterwards found to have been money thrown away.

The Lighting at Carlton Colville.—At a recent meeting of parishioners of Carlton Colville, it was decided by 44 votes to 25 not to adopt the Lighting Act in the village. A poll was thereupon demanded; and last Thursday week the result was made known—the majority against the lighting being only two.

Explosion of Gas at Tunbridge Wells.—On Thursday, the 8th inst., an explosion of gas took place on the premises of Messrs. J. G. Murdoch and Co., music warehouse, Chapel Street, Tunbridge Wells, whereby all the windows were blown out, and Mrs. Barnard, wife of the resident Manager, received severe injuries on the face and hands. Mr. Barnard promptly turned off the gas at the meter, and, notwithstanding her injuries, Mrs. Barnard helped to extinguish the flames. The explosion is believed to have been caused by a volume of gas coming into contact with the bye-pass flame of an incandescent gas-light.

The Gainsborough Gas-Works Purchase Question.—On Friday, the 9th inst., a meeting of owners and ratepayers was held at Gainsborough to consider the proposal of the District Council to purchase the gas-works undertaking. The Chairman of the Council, Mr. J. Dixon—presided, and explained the circumstances which had led up to the proposal being made. The Clerk, Mr. D. M. Robbs, submitted that the Council could at the present time make a fair bargain with the Company, that money was cheap, and that the Committee believed the works could be made profitable. Their value would be assessed on the net maintainable profits. He expressed the opinion that if the Council's predecessors had had a little more pluck, the ratepayers would have been reaping the advantages of the works to-day. Mr. J. D. Sandars spoke against the proposed purchase, and Mr. E. Pearson delivered a long speech—arguing that, though he was in favour of buying the works at a fair price, it was not right to saddle the town with a large expense. Mr. Housham replied to this, and gave a number of facts and figures showing how gas-works had been made to pay in other places. He advised the ratepayers to take no notice of the croakers who would not buy the concern 25 years ago. The result of the voting was a majority of five to one in favour of the Council; but Mr. Sandars demanded a poll.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 17.

Sulphate of Ammonia.—The market has been steady throughout the week with increased firmness towards the close; the quotations being £10 to £10 1s. 3d. per ton f.o.b. at the ports. Makers are pursuing a consistent policy of selling their production as it becomes available. Consumers are still taking a fair share of the output; and there has been more buying for "covering" purposes, in anticipation of the holidays and consequent interruption of transit. In the forward position, makers are firm at £10 5s. per ton, ordinary terms, f.o.b. Leith; and at £10 per ton, Beckton terms, London. Speculators continue to offer abroad at below the equivalent of these prices; but they are less persistent than they were a week or two ago.

Nitrate of Soda is firm at 7s. 6d. per cwt. for good up to 7s. 7½d. for fine quality.

LONDON, *Dec.* 17.

Tar Products.—A little more life characterizes benzol; and buyers are easier to deal with. It may be that the bottom price of benzol has been reached, in which case better prices may come with the new year. The excellent demand for creosote which has obtained now for some little time continues, notwithstanding the increased production. It is a perfect godsend to distillers, as their other products are difficult of sale, and some absolutely unsaleable at all. The present lot of the tar distiller is an unhappy one; but, buoyed up with never-failing hope, expectations for the coming year keep him going. Carbolic acid moves off freely; and values are maintained, while a reasonable demand continues for solvent naphtha, as well as for heavy naphthas. Prices, however, are low and unprofitable.

Average values are as follows: Tar, 14s. to 19s. 6d. Pitch, east coast, 24s. 6d.; west coast, 22s. Benzols, nominal, both 90's and 50's, 8½d. Toluol, 1s. Solvent naphtha, 1s. 2d. Heavy naphtha, 1s 2d. Crude, 30 per cent., naphtha, 3½d. Creosote, 3d. Heavy oils, 50s. Carbolic acid, 60's, 1s. 10½d. Creosote salts, 30s. Anthracene, nominal, "A," 3¾d.; "B," 2½d.

Sulphate of Ammonia is steadier; and slightly better prices are being paid. The outlook for the spring is encouraging; and the sphere of consumption is undoubtedly much larger than it has ever been before. Notwithstanding the enormously increased production from coke-ovens, all that is being made is being taken up; and stocks in makers' hands are dangerously low. The value at all ports is £9 17s. 6d. to £10 per ton, less 3½ per cent.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is a fairly active demand generally for the better qualities of round coal; and with all other descriptions of fuel in brisk request, there is an exceedingly strong tone through the market. Some of the leading Lancashire collieries are decidedly in favour of a further upward move in prices at the close of the month; and the question has been under discussion during the past week, both by the principal colliery firms in the Manchester district, and also by those in South-West Lancashire. Nothing definite has so far been decided; but any sudden advent of severe weather would almost unquestionably bring about a more or less general upward move. House-fire qualities are exceedingly firm at the full quotations of 11s. to 11s. 6d. per ton for best Wigan Arley; 9s. 6d. up to 10s. 6d., for Pemberton four-feet and seconds Arley; and 8s. to 8s. 6d., for common house-fire descriptions. Steam and forge coals, with a pressing demand for inland requirements and for shipment, tend to harden; and in some instances slightly higher prices are already being secured. For inland sales, ordinary steam and forge coals are fetching 7s. 9d. to 8s. 3d. per ton at the pit; while on shipping orders, steam coal ranges, according to quality, from 9s. up to 10s. per ton delivered at the Garston Docks, the High Level, Liverpool, or the Manchester Ship Canal. Engine classes of fuel are fully maintaining the recent advance; and in some instances special prices above present list rates are quoted, where new business comes forward. There is a continued shortness of supplies; and the lower qualities of slack are scarcely obtainable under 4s. to 4s. 3d. per ton, with medium sorts 4s. 6d. to 5s., and the very best slacks quoted at 5s. 3d. to 5s. 6d. For coke there is a brisk demand; and ordinary foundry qualities are fetching about 16s. per ton at the ovens in this district.

Northern Coal Trade.—There has been an exceedingly brisk demand for coal in the last few days, in preparation for the holidays; so that the whole of the northern collieries have been very fully employed. The heavy business has necessarily stiffened the prices of coal. Best Northumbrian steam coals are quoted at 9s. 9d. per ton f.o.b.; second class, at about 9s.; and steam smalls, at about 4s. 3d. In the gas coal trade, there is a very full demand; and nearly 25,000 tons daily are being sent on the average from Tyne Dock—the chief of the shipping places for Durham coals. Prices of gas coals are now quoted at about 9s. per ton for occasional cargoes, promptly; but for delivery over next year, about 8s. per ton is the f.o.b. quotation. Very large local coal contracts are pending. Gas coke is steady; and the very heavy production seems to be well taken up, especially near the shipping places. There is no alteration in prices this week.

Scotch Coal Trade.—With a continuing good business, prices are rising. The demand is, in fact, so heavy that manufacturers have in some instances difficulty in getting supplies. Splint is in greatest request, and is fetching the highest price. The rates quoted are: Main, 8s. 6d. to 8s. 9d. per ton f.o.b. Glasgow; ell, 9s. 6d. to 10s.; and splint, 9s. 9d. to 10s. The shipments for the week amounted to 150,814 tons—a decrease of 2700 tons on the previous week, and of 836 tons on the corresponding week of last year. For the year to date, the total shipments have been 9,464,094 tons—an increase over last year of 1,639,091 tons.

The Assessment of the Bury St. Edmund's Gas-Works.—The Bury St. Edmund's Gas Company have given notice of their intention to appeal against the increased assessment of their property by the Borough Assessment Committee. The assessment has been nearly doubled; and this, notwithstanding that the gas-works will need extensive alteration and improvement before long.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 1405.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	Oct. 13	10½	Alliance & Dublin 10 p. c.	21—22	+½	4 15 5
100,000	10	,,	7½	Do. 7 p. c.	16—17	..	4 8 3
300,000	100	July 1	5	Australian 5 p. c. Db.	105—107	..	4 13 6
200,000	5	Nov. 11	6	Bombay, Ltd.	6¼—6¾	..	4 2 11
40,000	5	,,	6	Do. New, £4 paid	4¼—4¾	..	5 1 1
380,000	Stk.	Aug. 12	12	Brentford Consolidated	275—280	..	4 5 9
240,000	,,	,,	9	Do. New	210—215	..	4 3 9
50,000	,,	,,	5	Do. 5 p. c. Prf.	140—145	..	3 9 0
159,375	,,	Dec. 15	4	Do. 4 p. c. Db. Stk.	128—133*	..	3 0 2
220,000	Stk.	Sept. 15	11½	Brighton & Hove Orig.	263—268	..	4 5 10
226,320	,,	,,	8½	Do. A. Ord. Stk.	190—195	..	4 7 2
933,500	Stk.	Aug. 31	5	Bristol, 5 p. c. max.	125—130	..	3 16 11
420,000	20	Sept. 29	10	British	4⅝—47	−3	4 5 1
50,000	10	Aug. 12	11½	Bromley, Ord. 10 p. c.	26—28	+1	4 2 2
75,000	10	,,	8½	Do. 7 p. c.	20—22	..	3 17 3
500,000	10	Oct. 13	6	Buenos Ayres (New) Ltd	9¼—10	..	6 0 0
98,122	Stk.	June 29	4	Do. 4 p. c. Db. Stk.	98—100	..	4 0 0
150,000	20	July 14	8½	Cagliari, Ltd.	29—30	..	5 10 0
100,000	10	Sept. 29	7	Cape Town & Dis., Ltd.	14—15	..	4 13 4
50,000	50	Nov. 2	6	Do. 6 p. c. 1st Mort.	57—59	..	5 1 8
550,000	Stk.	Oct. 13	13½	Commercial Old Stock	310—315	..	4 5 9
200,750	,,	,,	10½	Do. New do.	240—245	..	4 5 9
200,750	,,	Dec. 15	4½	Do. 4½ p. c. Db. do.	145—150*	+¼	3 0 0
800,000	Stk.	Dec. 15	10	Continental Union, Ltd.	200—205*	..	4 17 7
200,000	,,	,,	7	Do. 7 p. c. Prf.	187—192*	+½	3 12 11
51,600	Stk	Aug. 31	14	Croydon A 10 p. c.	305—310	..	4 10 4
168,400	,,	,,	11	Do. B 7 p. c.	255—265	..	4 3 0
555,000	Stk.	Aug. 12	5½	Crystal Palace Ord. 5 p. c.	125—130	..	4 0 9
60,000	,,	,,	5	Do. 5 p. c. Prf.	140—145	..	3 9 0
486,090	10	July 28	11	European, Ltd.	23—24	..	4 11 8
354,060	10	,,	11	Do. £7 10s. paid	17—18	..	4 11 9
5,922,230	Stk.	Aug. 12	12½	Gaslight & Coke, A, Ord	285—290	..	4 4 6
100,000	,,	,,	4	Do. B, 4 p. c. max.	120—125	..	3 4 0
665,000	,,	,,	10	Do. C, D, E, 10 p. c. Prf.	308—313	..	3 3 11
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	152—157	..	3 3 8
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	233—238	..	3 3 0
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	195—200	..	3 10 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	308—313	..	3 3 11
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	185—190	..	3 3 2
1,061,150	,,	Dec. 15	4	Do. 4 p. c. Db. Stk.	130—132*	+1	3 0 7
294,850	,,	,,	4½	Do. 4½ p. c. do.	145—150*	−½	3 0 0
958,000	,,	,,	6	Do. 6 p. c. do.	195—200*	+3	3 0 0
70,000	10	Nov. 11	8	Hongkong & China, Ltd.	13½—14½	..	5 10 4
3,800,000	Stk.	,,	10	Imperial Continental	223—227	+1	4 8 1
376,400	100	Aug. 2	4	Do. 4 p. c. Dbs. Red.	98—101	..	3 19 3
473,600	Stk.	Aug. 12	3½	Do. 3½ p. c. Db. Stk. ,,	102—105	..	3 6 8
660,000	100	Oct. 1	5	Met. of Melbourne 5 p. c. Db.	110—112	..	4 9 3
				Met. of Melbourne 4½ p. c. Db.	105—107	..	4 4 1
250,000	100	,,	4½				
75,000	5	Nov. 30	6	Malta & Medn., Ltd.	4¾—5¼	..	5 14 3
541,920	20	Nov. 11	5	Monte Video, Ltd.	13—14	..	7 2 10
617,946	Stk.	Aug. 31	9¾	Newc'tle & Gatesh'd Con.	232—233	..	4 2 8
252,355	Stk.	Jan. 3	3½	Do. 3½ p. c. Db. Stk.	113—117	..	2 19 10
150,000	5	Nov. 30	8	Oriental, Ltd.	7—7½	..	5 6 8
135,000	5	,,	8	Do. New, £4 10s. pd.	6¼—6¾	..	5 6 8
15,000	5	,,	8	Do. do. 1879, £1 pd.	1¼—1¾	..	4 11 5
60,000	5	Sept. 29	7	Ottoman, Ltd.	5—5½	..	6 6 2
500,000	100	Dec. 1	6	People's Gas & 2nd M. of Chicago Bd.	102—106	..	5 13 2
848,070	10	Oct. 13	6	River Plate Ord.	9—9½	..	6 6 4
250,000	Stk.	June 29	4	Do. 4 p. c. Db. Stk.	99—101	..	3 19 3
250,000	10	Sept. 29	10	San Paulo, Ltd.	15—16	..	6 5 0
135,000	Stk.	Sept. 15	10	Sheffield A.	242—245	..	4 1 8
209,053	,,	,,	10	Do. B.	242—245	..	4 1 8
447,427	,,	,,	10	Do. C.	242—245	..	4 1 8
5,600,000	Stk.	Aug. 12	5⅓	South Metrop., 4 p. c. Ord.	136—139	−1	3 16 7
1,460,000	,,	July 14	3	Do. 3 p. c. Db. Stk.	102—105	..	2 17 2
60,000	Stk.	Aug. 31	12	Tottenham and Edmonton A.	280—290	..	4 2 9
60,000	,,	,,	9	Tottenham and Edmonton B.	200—210	..	4 5 9
182,380	10	June 10	7	Tuscan, Ltd.	10—11	..	6 7 3
149,900	10	July 1	5	Do. 5 p. c. Dbs. Red.	100—103	..	4 17 1
				WATER COMPANIES.			
746,184	Stk.	June 29	11†	Chelsea, Ord.	315—320	+2	3 8 9
150,000	,,	,,	5	Do. 5 p. c. Prf.	170—175	..	2 17 2
160,000	,,	,,	4½	Do. 4½ p. c. Pf. Stk., 1875	148—152	..	2 19 3
175,785	,,	Sept. 29	4½	Do. 4½ p. c. 1 b. Stk.	157—162	..	2 15 7
1,730,560	Stk.	Oct. 13	7	East London, Ord.	212—217	..	3 4 6
654,740	,,	June 29	4½	Do. 4½ p. c. Db. Stk.	158—162	..	2 15 7
390,000	,,	,,	3	Do. 3 p. c. Db. Stk.	102—104	−1	2 17 8
700,000	50	Dec. 15	7½	G'd Junct'n, 10 p. c. max.	112—115*	..	3 5 3
310,000	£stk.	Sept. 29	4	Do. 4 p. c. Db. Stk.	138—143	..	2 15 11
708,000	Stk.	Aug. 12	14	Kent	365—370	..	3 15 8
160,000	,,	,,	7	Do. New, 7 p. c. max.	212—217	..	3 4 6
1,043,800	100	June 29	10½†	Lambeth, 10 p. c. max.	300—305	..	3 8 10
406,200	100	,,	7½	Do. 7½ p. c. max.	230—235	..	3 9 10
350,000	Stk.	Sept. 29	4	Do. 4 p. c. Db. Stk.	138—143	..	2 15 11
500,000	100	Aug. 12	13¼	New River, New Shares	430—435	−2	3 0 11
1,000,000	Stk.	July 28	4	Do. 4 p. c. Db. Stk.	138—143	..	2 15 11
902,300	Stk.	June 29	7½	Southw'k & V'xhall, Ord.	177—181*	+3¾	4 2 5
126,500	100	,,	7½	Do. do. 7½ p. c. max.	167—173*	+3½	4 7 3
489,200	Stk.	,,	5	Do. do. 5 p. c. Prf.	168—171*	+½	2 18 6
1,019,585	,,	Oct. 13	4	Do. 4 p. c. A Db. Stk.	138—143	..	2 15 11
1,155,066	Stk.	Dec. 15	10	West Middlesex	290—295*	..	3 7 9
200,000	,,	,,	4½	Do. 4½ p. c. Db. Stk.	160—163*	+½	2 15 3
200,000	,,	Sept. 15	3	Do. 3 p. c. Db. Stk.	102—105	..	2 17 2

* Ex div.

† Next dividend will be at this rate.

Public Incandescent Gas Lighting.—The average duration of the Auer mantles employed for public lighting in Charlottenburg last year was 371·52 hours, and that of the chimneys 966·14 hours, in lamps lighted only in the evening; the figures being respectively 939·42 and 2441·53 hours for lamps burning all night. The average consumption was 126 litres (4·4 cubic feet) of gas per hour.

Acetylene Gas Lighting on the Continent.—According to the "Journal de l'Acétylène," acetylene gas lighting is about to be introduced into the town of Zobten, near Breslau, where 88 applications have been received for 287 burners. The Municipality of Berent have adopted acetylene gas for lighting the streets and avenues; and it is expected that it will be used for lighting private houses. Acetylene gas-works are about to be constructed near the Central Railway Station in Munich, to supply the carriages on the Bavarian line. A cellulose factory at Kelheim is also to be lighted by the gas.

New Joint-Stock Companies.—The Leeds Gas-Retort Company, Limited, has been registered with a capital of £10,000 in £1 shares, for the purpose of acquiring the business of the Yeadon Gas-Retort Company, Limited, including the gas trial plants at Leeds and Ripon, and to acquire, own, and work several British patents connected with gas-retorts and apparatus. The Anti-Vibration Incandescent Lighting Company, Limited, has been registered with a capital of £25,000, in £1 shares, to acquire, amalgamate, and carry on the undertakings of the Anti-Vibration Incandescent Lighting Company, Limited, and the Acme Unbreakable Chimney Company, Limited.

Frontagers and Street Lighting at Ipswich.—Hitherto it has not been the practice of the Ipswich Corporation to light streets which are not repairable by the inhabitants at large. The Paving and Lighting Committee now consider it desirable that a change should be made in this respect, and that where streets are fairly built up, the frontagers should be compelled to provide the means for lighting, and the streets should thenceforth be lighted at the expense of the Authority, although the Authority may not consider that the time has arrived for compelling the execution of works of sewering, flagging, channeling, &c. Plans and estimates have been prepared for lighting certain streets accordingly. The question was considered by the Town Council last Wednesday; and the Committee's proposals were adopted.

Gas and Water Charges in Large Towns.—The Borough Treasurer of Preston (Mr. J. Carter) has compiled, from official returns, his annual table of the rates, and a summary of the gas and water charges, in 45 municipal cities and boroughs, with populations ranging from 39,000 to 668,000, and rateable values from £149,200 to £3,846,321. The lowest net charge for gas is at Plymouth (1s. 9d.); Newcastle and Gateshead standing next at 1s. 9¾d.; Sheffield, at 1s. 10d.; York, at 1s. 11d.; and Ashton, Halifax, and Middlesbrough, at 2s. The highest charge is at Blackburn (3s. 2d.); Preston coming next at 3s. 1¼d. With regard to water, the charge in the pound for a house of £15 rateable value is highest at Rochdale (2s.), and lowest at Liverpool (7½d.); Manchester and Brighton (9d.) and Birkenhead (10d.) coming next.

Assault on a Welsbach Company's Representative, and Its Consequences.—Early in the present month, Mr. Edward Lane, in the service of the Welsbach Incandescent Gas-Light Company, Limited, summoned Mr. J. S. Robertson, of Widemarsh Street, Hereford, for an assault. In the course of his duties, Lane called upon the defendant to inform him that he was using infringements of the Company's patents. Whereupon he asked by what law plaintiff dared to suggest that he should not be allowed to use anything he chose to buy; and altogether Lane met with such a warm reception that the proceedings above referred to had to be taken. The Magistrates considered that justice would be done by the imposition of the nominal fine of 1s. The Welsbach Company, however, took another view of the matter, and promptly obtained an interim injunction against Mr. Robertson, who has been glad to settle the matter by handing over the infringements and paying £10 10s. costs.

New Water Tower and Reservoir at Gainsborough.—The opening of the new reservoir and tower forming part of the Gainsborough water extension scheme took place last Wednesday. The formal ceremony was performed by Mr. John Dixon, J. P., Chairman of the District Council. Those present were informed that the total cost of the tower, reservoir, and rising-main will be, approximately, £7000. The length of the rising-main from the artesian well to the tower is 2000 feet, with a total rise of 103 feet. The reservoir is 16 feet deep, with a capacity of 1,004,350 gallons. The tower is a hexagonal structure, 75 feet in height. The tank will hold about 7200 gallons of water, sufficient to supply the town for three or four days. The whole of the works have been carried out under the supervision of Mr. Henry Riley, Engineer and Surveyor to the Council. At the close of the ceremony, Mr. Dixon entertained the members of the Council to luncheon, when some interesting speeches were given, detailing the progress of the water undertaking.

The Water Powers of Parish Councils.—On the above subject the "Local Government Journal" says: "The precise extent of the powers possessed by Parish Councils in the matter of water supply has never yet been determined. That they have powers cannot be questioned, for the Act of 1894—section 8 [i] [*c.*]—enables them to utilize any well, spring, or stream within the parish, and to provide facilities for obtaining water therefrom, and in section 9 there is a provision clearly implying that a Parish Council may acquire land for purposes of water supply, except by compulsory procedure. At the same time, the Act states in section 8 [iii.] that it shall not be construed to derogate from any obligation of District Councils with respect to a supply of water or the execution of sanitary works; and it is perfectly clear that, while the latter authorities retain all their powers under the Public Health Acts with regard to the laying of mains, the enforcement of water supplies to houses, and the levying of water-rates, Parish Councils possess none of these powers. Whatever functions are intended to be conferred by such indefinite expressions as 'utilize' and 'provide facilities' must therefore be of very minor scope. As to the execution of a general scheme of water supply involving reservoirs, pumps, mains, &c., unless the Parish Council are acting as agents of the superior District Council, this would seem to be quite *ultra vires*."

No. 2010.

Season 1898.

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The Truro Water-Works Purchase Scheme.—The Truro Town Council have appointed Mr. Mansergh as their Engineer in the negotiations with the Water Company for the purchase of their works.

The Stockport Water-Works Purchase Question.—The shareholders of the Stockport Water Company yesterday week approved of the action of the Directors in agreeing to dispose of the undertaking to the Corporation on terms representing £786,000. The general feeling in the district is that, though the price is high, the Corporation are doing wisely to obtain the control of the water supply, even at the risk of increased rates.

Automatic Coal-Gas Retort Company, Limited.—At the annual general meeting of this Company to-day, the Directors will present the accounts for the year ending Sept. 30 last. The profit and loss account shows a net profit of £2004 on the year's working; and, after paying off the debit balance of £1186 brought forward, there remains a sum of £818, which it is proposed to carry to the current year's account. As the original Coze patent owned by the Company will shortly expire, the Directors, in view of the importance of the invention, have taken the necessary steps to obtain a prolongation of it.

Improvement of the Minehead Gas Company's Works.—A meeting of the shareholders of this Company was held last Tuesday, when it was resolved that the Directors be empowered to borrow £700 at 3½ per cent., on debenture mortgage, for the purpose of laying new mains and for other work. The Company recently enlarged their works at a cost of above £3000; and they are now laying larger mains in the principal streets—the development of Minehead as a health resort rendering these improvements necessary. The whole of the work has been carried out under the direction of the Company's advising Engineer, Mr. Henry A. Willey, Assoc.M.Inst.C.E., of Exeter.

The Proposed Purchase of the Ashburton Gas-Works.—A special meeting of the Ashburton District Council was held yesterday week to consider the draft Provisional Order for the purchase of the gas-works. This was approved. The resolution of the public meeting in favour of a poll of the ratepayers was laid before the Council by the Portreeve. The Hon. R. Dawson proposed that the ratepayers be informed that the proper course for any objection to the scheme was by letter to the Local Government Board. Mr. Mitchelmore, who dissented from the resolution approving of the Provisional Order, proposed that a poll be granted; but this was defeated by five votes to four, and the resolution was carried.

Collapse of a Gasholder Tank in New York.—Considerable consternation was caused in New York last Tuesday evening by the collapse of the large steel gasholder tank belonging to the Consolidated Gas Company in Avenue "A," the next street parallel to First Avenue towards East River. The tank was being tested at the time of the accident, and contained 8 million gallons of water. This poured in a huge wave over the surrounding district, and caused great destruction, as well, unfortunately, as loss of life. According to a telegram received through Reuter's Agency on Wednesday, twenty persons were injured by the catastrophe; and six bodies were found in the *débris*. The streets in the vicinity were strewn with rubbish.

The Price of Gas in Berlin.—The recommendation of the deputation appointed to advise the municipal authorities as to the practicability of reducing the price of gas in Berlin—to the effect that a price of 12 pfennige per cubic metre (3s. 4¾d. per 1000 cubic feet) should be charged for all gas sold, whether consumed for lighting or other purposes—has been rejected by the civic authority; and consequently the hopes expressed in the "JOURNAL" for the 22nd ult. (p. 1153) that Berlin would henceforth have a reasonably cheap supply of illuminating gas, will not at present be realized. The deputation has now been requested to discuss the abatement of meter-rents, and the introduction of a rebate on illuminating gas consumed for industrial purposes. The present system of charging one price for gas consumed for lighting, and another price for gas otherwise employed, entails the use and additional expense of duplicate services and meters.

The Carmarthen Town Council and the Welsh Water Scheme for London.—At a meeting of the Carmarthen Town Council last Tuesday, the Town Clerk (Mr. R. M. Thomas) said he had received the Parliamentary Notices from the Agents of the London County Council with regard to the proposed establishment of reservoirs in Wales to supply the Metropolis with water. It appeared that it was intended to dam up the main stream of the Towy at the source near the borders of Carmarthenshire, Cardiganshire, and Radnorshire. The effect it would have upon Carmarthen would depend entirely upon the summer flow of water at that point. Alderman White: So that below the dam it will be a dry stream? The Town Clerk: Quite so, except when the reservoirs are full. Alderman Rogers did not think the town would suffer much, as there were plenty of tributaries between the spot in question and the town. The Town Clerk said it would depend upon the amount of water there in the summer time, because during a dry summer the borough could not afford to lose any of the present volume of the Towy. It was decided to present a petition against the scheme.

Arbitration Respecting Land for Water-Works Purposes at Brighton.—An arbitration relating to a claim by Messrs. H & H. C. Bridger for compensation for land compulsorily acquired by the Brighton Corporation at Shoreham for water-works purposes was commenced last Wednesday. The proceedings took place in the Royal Pavilion, before the Deputy Sheriff and a Special Jury. Mr. Pember, Q.C., Sir William Marriott, Q.C., and Mr. J. E. Banks appeared on behalf of the Corporation; and Messrs. Bridger were represented by Sir Edward Clarke, Q.C., and Mr. Edward Boyle, Q.C. Sir Edward Clarke made the opening statement, setting forth the claim of Messrs. Bridger. They asked 1d. per 1000 gallons for the water taken by the Corporation. The amount of water was estimated at 1,500,000 gallons per diem, which would represent £2281 per year. Twenty-five years' purchase of this sum would be £57,025; and to this must be added 10 per cent. for compulsory purchase. The land in question is 47½ acres in extent. It was believed that the inquiry would last several days; but it unexpectedly came to a close on Friday—a compromise being agreed to, under which the Corporation pay £6000 for the land, and Messrs. Bridger are to receive 1d. per 1000 gallons on all water used by the Corporation outside the Shoreham district.

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SALTLEY WORKS, BIRMINGHAM	2,000,000	OTTAWA (Second Contract)	250,000
COLCHESTER	300,000	BRANTFORD (Remodelled)	200,000
BIRKENHEAD	2,250,000	ST. CATHERINES (Remodelled)	250,000
SWINDON (New Swindon Gas Co.)	120,000	KINGSTON, PA.	125,000
SALTLEY WORKS, BIRMINGHAM (Second Contract)	2,000,000	PETERBOROUGH, ONT.	250,000
WINDSOR STREET WORKS, BIRMINGHAM (Second Contract)	2,000,000	WILKESBARRE, PA.	750,000
HALIFAX	1,000,000	ST. CATHERINES (Second Contract)	250,000
TORONTO	250,000	BUFFALO, N.Y.	2,000,000
OTTAWA	250,000	WINNIPEG, MAN.	500,000
LINDSAY (Remodelled)	125,000	COLCHESTER (Second Contract)	300,000
MONTREAL	500,000	YORK	750,000
		ROCHESTER	500,000
		KINGSTON, ONT.,	300,000

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The Purchase of Land for the Washburn Valley Water-Works of the Leeds Corporation.—The Washburn Lands Purchasing Committee (a section of the Leeds Corporation Water Committee) have decided to purchase certain other farms in the Washburn Valley, with the view of preventing the water supply of the city being polluted. So far the Committee have purchased 22 farms, including two licensed houses and five blocks of cottage property, and comprising some 617 acres, for £32,474 14s. This has been accomplished without appealing to arbitration.

The Annual Report of the Munich Gas-Works.—The consumption of gas at Munich during the working year 1897-98, shows an increase of 4·97 per cent. on that of the preceding year. There was a slight falling off in the quantity of gas consumed for public lighting; but there were increases of 5·6 per cent. in the private consumption for illuminating purposes, of 15·2 per cent. in the amount used in gas-engines, and of 2·4 per cent. in that used for heating and cooking. The year's working has resulted in a net profit of 1,591,346 marks (about £79,567) being earned by the Gas Company.

The Harrogate Water-Works Transfer.—The Harrogate Town Council yesterday week authorized the signing of a cheque for £852, being the amount of the Water Company's costs prior to the winding up of the concern. In the course of the proceedings, Alderman Fortune made a serious charge against the Company. He said that ever since the Corporation commenced negotiations with them, they had been treated in an extremely unsatisfactory way. The Company had tried to put the Corporation to as much inconvenience and expense as possible. Still it was the best policy to pay the money, and be done with them.

The New Water Scheme for Carlisle.—The Special Committee of the Carlisle Town Council appointed to deal with the Geltsdale water scheme considered, at their meeting yesterday week, a proposal (submitted by Mr. Corbett and Mr. Tweedy) that Mr. C. B. Newton, the Engineer of the Gas and Water Works, be appointed sole Engineer to carry out the new works on a commission of 2½ per cent. on the estimates. The estimates amounted to about £130,000, the commission on which would reach £3250, or about £1100 a year, assuming that the execution of the works were to occupy three years. It was stated that this arrangement would not interfere with the discharge of Mr. Newton's ordinary duties. After some conversation, the further consideration of the subject was postponed, in order that the Gas and Water Committee might be consulted on the point.

Voting of Gas Shareholders on the Gas-Works Purchase Question at Rushden.—As already reported, a movement has been organized at Rushden for the purchase of the gas-works by the town. The District Council, however, appear to be in a little quandary in connection with the matter, as no less than seven of the members are shareholders or Directors of the Gas Company. The Council therefore communicated with the Northamptonshire County Council, praying them to grant a dispensation to the seven members to allow them to vote on the question at their meetings. The matter came before the County Council last Saturday week, when the Vice-Chairman (Mr. J. R. Wilkinson) moved that the dispensation be granted, as he thought it would be a great pity for the members in question to have to retire from the District Council in connection with which they had done such good work. Mr. Abbott seconded the proposal. Earl Spencer thought the County Council ought to proceed with the greatest possible care in considering such an important application, as they had to think of the precedent that would be set up. Ultimately, upon the suggestion of his Lordship, it was agreed to refer the question to the Local Government Board for their consideration and advice.

The Maidstone Town Council and the Water Supply.—Since the Maidstone Town Council have failed in their water-works purchase scheme, they have evinced a strong desire to establish confidence in the Water Company's supply. A communication was recently forwarded by them to the Company asking that analyses of the water should be made and published. In response to this, the Directors instructed their Engineer (Mr. W. J. Ware) to show the Mayor, or anyone else who wished to see it, the most recent analysis made by their own Analyst. Beyond this, Mr. Ware, in order to show what his Company were doing in the way of protecting their supply, wrote informing the Council that he had interviewed the owners and tenants of the Boarley and Cossington supply gathering-grounds (about 200 acres), and had concluded a provisional arrangement for the same to be protected. The correspondence on the subject came before the Council last Wednesday; but it did not appear to promise sufficient to please the members. The discussion of the matter ended in a resolution being passed, requesting the Company to furnish the Council with a monthly analysis of the water, so that it might be made public—the proposer (Mr. Hewett) stating that he considered the analysis of the Company should be published as well as that of the Medical Officer.

New Water-Works Loan for Southampton.—Mr. E. P. Burd, one of the Local Government Board Inspectors, held an inquiry at Southampton last Tuesday, relative to an application by the Corporation for a Provisional Order to borrow additional money for the purposes of their water undertaking. The Town Clerk (Mr. G. P. Nalder) explained that the application was for an additional or supplemental Provisional Order to those issued in 1891, 1894, and 1897, to extend the borrowing powers, given to the Corporation by their Water Act of 1875. By this Act they had power to borrow £60,000 for the water-works; and since then orders had been given sanctioning the extension of the amount to £124,500, made up by £33,500 in 1894, and £25,000 in 1897. Another £25,000 was required for additional works. Mr. W. Matthews, the Water Engineer, stated that the £124,500 was practically exhausted. During the next five years, the Corporation would require £23,000 for the purpose of executing further works, in order to meet the increasing demands for water for domestic and sanitary purposes. It was very difficult to cope with the demands at present; but they had been able to afford a constant supply. The water undertaking had been very remunerative, and would be more so in the future. Some particulars as to the rates were also furnished by the Borough Accountant (Mr. A. Ramshaw).

Messrs. G. Pettigrew and Co. have received an order to erect their complete sulphate of ammonia plant at the East Grinstead Gas-Works.

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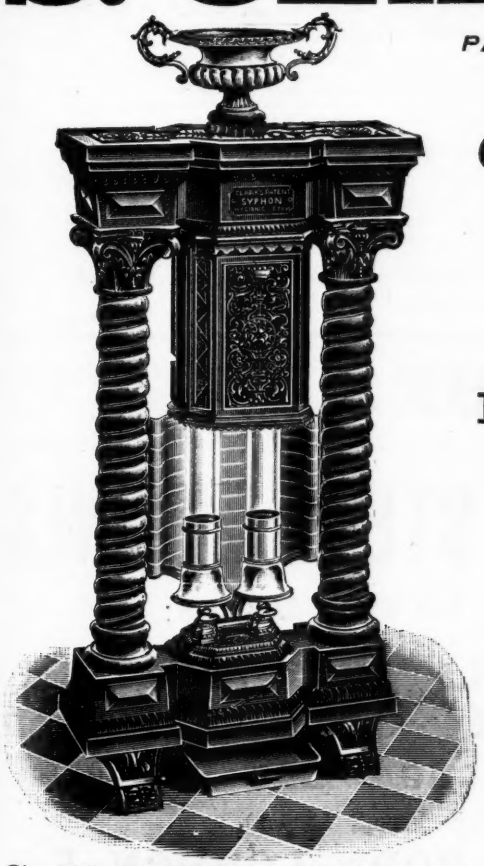

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CHRISTMAS HOLIDAYS.

In consequence of the CHRISTMAS HOLIDAYS, the next issue of the "JOURNAL" will be sent to press on FRIDAY. Correspondents and Advertisers will therefore oblige by forwarding their Communications as early as possible.

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PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for TOWNS, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.

Telegraphic Address: "PORTER LINCOLN."

[For Illustrated Advertisement, see Dec. 6, p. 1274.]

WANTED, Carbon in 4 Ton Lots, or more; also OIL CARBON.

State Price, f.o.r. at nearest Station, to No. 3081, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS Engineer and Manager requires a SITUATION at home or abroad.

Address No. 3180, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

PREPAYMENT Collector and Inspector is open for RE-ENGAGEMENT after Jan. 1 next. Quick, Steady, and Reliable. Total Abstainer. Character unimpeachable. References given.

Address No. 3185, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS Stoker wanted. Give Information and state Wages required.

Apply to the MANAGER, Gas-Works, Halesowen, near BIRMINGHAM.

WANTED, a Young Man, used to Main and Service Laying, for small Gas-Works. State Wages and previous Employment.

Apply to H. C. P., 55, HIGH HOLBORN, W.C.

WANTED, a Draughtsman, with experience of Elevating and Conveying Machinery and Inclined Retorts. State Age, Experience, and Salary expected.

GRAHAM, MORTON, AND CO., Black Bull Street, LEEDS.

WANTED, a good Stoker, used to Shovel Charging, Generator Furnaces, and Engine and Exhauster. Permanency. Abstainer preferred. Wages 30s. per week.

Apply, with Reference, stating Age, to F. W. TORPEY, Gas-Works, WHITWICK.

ALDERSHOT GAS AND WATER COMPANY.

THE Directors of the Aldershot Gas and Water Company require the services of a SECRETARY and ACCOUNTANT, who must be thoroughly acquainted with all the duties appertaining to the Office. Salary £250 per annum.

Applications, with three recent Testimonials, to be forwarded by the 13th of January, 1899, addressed: HONORARY SECRETARY, Gas and Water Company, ALDERSHOT.

Aldershot, Dec. 10, 1898.

GWYNNE & BEALE'S

PATENT

GAS-EXHAUSTERS AND STEAM-ENGINES

FOR FULL PARTICULARS, APPLY TO THE MAKERS:

GWYNNE & CO.,

Telegrams: "GWYNNEGRAM, LONDON."

HYDRAULIC AND GAS ENGINEERS

(Late Essex Street Works, Victoria Embankment, London),

Telephone No. 95 Holborn.

BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

WANTED, a Gas Stoker used to Shovel Charging, Engine and Exhauster. Permanency to an active and steady Man. Good Wages.
Apply, with References and stating Age, to No. 3187, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, an experienced Draughtsman. One accustomed to Gas Plant preferred. Permanency to a good Man.
Apply, by letter, stating Experience, Age, and Salary required, to No. 3181, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, for an Estate, a good WORKING MAN who thoroughly understands the making of Gas, can repair Gas and Water Mains, and also look after the Hot-Water Boilers. Wages 30s. per week, free House, Coal, and Gas.
Apply to Mr. MARSHALL, The Park, Hatfield, HERTS.

WANTED, a thoroughly reliable Gas- FITTER. Must be experienced in General House Fitting, Iron and Compo., Fixing Stoves and Meters, and Main and Service Laying.
Apply, stating Age, Experience, and Wages required, to No. 3186, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ROTHERHAM CORPORATION GAS-WORKS.

WANTED, a good Outside Foreman. Must be well up in Fitting, Main Laying, and all work to be executed on the Distributing System, and especially used to the control of Workmen.
Applications, with Testimonials and Wages required, to be sent to the undersigned on or before Wednesday, Dec. 21.

FRANK A. WINSTANLEY,
Engineer and Manager.

CORPORATION OF LEICESTER.
(GAS AND ELECTRIC LIGHTING DEPARTMENT).

GAS-FITTERS.

PERMANENT employment offered to six first class Men, thoroughly trained in both Iron and Compo. Work. Age 25 to 35. Wages 8d. per hour.
Applications, with Testimonials as to Character, &c., to

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Offices: Millstone Lane,
Leicester, Dec. 13, 1898.

BOMBAY GAS COMPANY, LIMITED.

ASSISTANT MANAGER WANTED.

THE Bombay Gas Company, Limited, require an ASSISTANT MANAGER to proceed to Bombay early in March next. Engagement Five Years. Age from 25 to 30.
Applicants must be unmarried, and be practically acquainted with Gas Engineering, Manufacture, and Accounts, as well as qualified to undertake any duties (indoor and outdoor) which may be allotted to him by the Manager.
Salary £300 Sterling per Annum. Horse allowance. House, Fuel, and Gas free, and First-class Passage out and home.
Applications, by letter, stating Age, accompanied by *copies* of Testimonials, to be addressed to the Secretary of the Company, 6, Drapers Gardens, London, E.C., and sent in on or before the 3rd of January prox.

FOR SALE—A Sulphate of Ammonia Plant, suitable for Works carbonizing 4000 Tons of Coal per annum. Built by Abbott & Co., London.
Apply to the CLIFTON AND KERSLEY COAL COMPANY, LIMITED, Clifton, MANCHESTER.

TENDERS FOR GAS COAL.

THE Magistracy of Copenhagen are prepared to receive TENDERS for the supply and delivery of 130,000 Tons of best GAS COAL during the Year 1899 from April to the end of December. The Magistracy reserve the right to divide the Contracts between two or more Contractors.
Further Information and Conditions for the delivery may be obtained on application to the Lighting Department of Copenhagen, Vestre Boulevard, Copenhagen.
The Tenders (sealed) to be sent to the Magistracy of Copenhagen (4th Division) before the 14th of January, 1899, Twelve o'clock, at which time the Tenders will be opened in the presence of the parties tendering who are in attendance.

THE MAGISTRACY OF COPENHAGEN.
Dec. 12, 1898.

BOROUGH OF BRIGHOUSE,
(GAS DEPARTMENT.)

INSTALLATION OF INCLINED RETORTS.

THE Gas Committee are prepared to receive TENDERS for an Installation of INCLINED RETORTS, together with Coal and Coke Elevators and Conveyors, at their Mill Lane Station.
Further Particulars and Information can be obtained on application to the Engineer.
Sealed Tenders, endorsed on the outside "Inclined Retorts," must be sent in to me, the undersigned, on or before Noon on Friday, the 6th day of January, 1899.
The Committee do not bind themselves to accept the lowest or any Tender.

JAMES PARKINSON,
Town Clerk.

Municipal Offices, Brighouse,
Dec. 16, 1898.

HAWORTH URBAN DISTRICT COUNCIL.

TENDERS are invited for the purchase of the Council's surplus TAR and LIQUOR for the Year ending Dec. 31, 1899, delivered on Rails at Haworth Station.
Tenders to be sent to me not later than Dec. 29, 1898.

WM. ROBERTSHAW,
Clerk.

Burlington Chambers,
North Street, Keighley.

BOROUGH OF WARRINGTON.
(GAS DEPARTMENT.)

THE Gas Committee of the Warrington Corporation invite TENDERS for the following Goods: (1) TAR STILL, EVAPORATOR, &c. (2) PURIFIER GRIDS. (3) ROOF. (4) RETORT-FITTINGS. (5) FIRE-BRICKS, CLAY, RETORTS, &c. (6) COKE STORAGE PLANT.
For further Particulars, apply to Mr. W. S. Haddock, Engineer, not later than Dec. 31.

FREDK. TAYLOR,
Secretary.

Gas Offices, Warrington,
Dec. 17, 1898.

THE Directors of the Worksop Gas Company invite TENDERS for the purchase of the surplus TAR and the AMMONIACAL LIQUOR made at their Works from the 1st of January to the 31st of December, 1899.
Tenders for Tar to state Price per ton delivered into Purchaser's Tanks at the Worksop Railway Station.
Tenders for Liquor to state Price per ton as tested by Twaddell's No. 1 Hydrometer, delivered into Boats near the Company's Works; or price per ton delivered into Purchaser's Tanks at the Railway Station.
The Directors do not bind themselves to accept the highest or any Tender.
Tenders to be sent in by the 31st of December.
Worksop, Dec. 8, 1898.

RAMSGATE CORPORATION.
(GAS DEPARTMENT.)

TENDERS invited for 2500 (12-feet lengths) 6-inch GAS-PIPES, 500 4-inch GAS-PIPES, together with about 5 Tons of BENDS, BRANCHES, &c.

(WATER DEPARTMENT.)

Also for 375 4-inch and 125 3-inch WATER-PIPES, in 12-feet lengths; and about 4 Tons of TEES, BENDS, &c.
Tenders to be sent in addressed to the Chairman of the Gas and Water Committee, Hardres Street, not later than Dec. 31, endorsed "Tender for Pipes."
The Committee do not bind themselves to accept the lowest or any Tender.
Specification and full Particulars on application to

WILLIAM A. VALON,
Engineer.

RAMSGATE CORPORATION.
(WATER DEPARTMENT.)

TENDERS invited for Compound Con- DENSING BEAM-ENGINE, working up to 100 Brake Horse Power, delivered and fixed at the Whitehall Pumping-Station.
Tenders to be sent in addressed to the Chairman of the Gas and Water Committee, Hardres Street, not later than Dec. 31, endorsed "Tender for Compound Engine."
The Committee do not bind themselves to accept the lowest or any Tender.
Plans, Specifications, and full Particulars on application to

WILLIAM A. VALON,
Engineer.

COUNTY BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS for the supply of: (1) WET GAS-METERS (Ordinary and Prepayment), (2) DRY GAS-METERS (Ordinary and Prepayment), (3) FIRE-CLAY GOODS (Horizontal Retorts), (4) WROUGHT-IRON GOODS, (5) STEEL GOODS, (6) IRONMONGERY, (7) VALVES, (8) HORSE CORN, (9) TARRED GASKIN, &c., (10) STOKERS' GLOVES, and (11) CLOTHING and CAPS, required during the ensuing Twelve Months.
Forms of Tender and further Particulars may be obtained on application to Mr. Thomas Holgate, C.E., Gas Engineer, Halifax.
Tenders, properly endorsed, to be sent to the undersigned before Ten o'clock a.m., on Wednesday, the 28th of December, 1898.
The person whose Tender is accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation.
The Committee do not bind themselves to accept the lowest or any Tender.

By order,
KEIGHLEY WALTON,
Town Clerk.

NEWCASTLE AND GATESHEAD WATER COMPANY.

TO BE SOLD, by Auction, in the Board- Room of the Company's Offices, Pilgrim Street, Newcastle-on-Tyne, on Tuesday, Jan. 17, 1899, at Half-past Twelve o'clock precisely, by Mr. Charles A. Joel, in such Lots as are provided for in the said Company's Act of 1894—

FORTY THOUSAND POUNDS
FIVE PER CENT. PREFERENCE STOCK (1894).

Printed Particulars and Conditions of Sale may be had at the Company's Offices; of Messrs. George Armstrong and Sons, Solicitors, Newcastle-on-Tyne; or of the Auctioneer, 66, New Bridge Street, Newcastle-on-Tyne.

GEORGE SMITH,
Secretary.

Newcastle-on-Tyne
Dec. 13, 1898.

STAINES RESERVOIRS JOINT COMMITTEE.
INCORPORATED BY ACT OF PARLIAMENT, 59 AND 60 VIC., CAP. 241.

ISSUE OF £500,000 £3 PER CENT. DEBENTURE STOCK.
MINIMUM PRICE, PAR.

Payment of Interest guaranteed by the three following Companies:—
The West Middlesex Water-Works Company,
The Grand Junction Water-Works Company, and
The New River Company, jointly and severally.

NOTICE is Hereby Given, that the Joint Committee are prepared to receive TENDERS for the above amount, being a further portion of the DEBENTURE STOCK created by the above Act and by the Act of 1898, bearing Interest at £3 per cent. per annum, payable Half Yearly, and redeemable after the expiration of 25 Years from the date of issue, subject to Six Months' Notice being given by the Committee.
The Staines Reservoirs Act, 1898, authorizes Trustees to invest Trust Funds in this Stock.
Tenders must be delivered at the Office of the Committee, No. 19, Marylebone Road, N.W., not later than Two o'clock p.m., on Wednesday, the 21st of December next.
Particulars and Conditions, together with Form of Tender, may be obtained at the said Office, or will be forwarded on application; also of Messrs. Hollams, Sons, Coward, and Hawksley, Solicitors, 30, Mincing Lane, E.C.; and of Messrs. Prescott, Dimsdale, and Co., Limited, Bankers, 50, Cornhill, E.C.
By order of the Joint Committee,

F. H. WYBROO,
Secretary.

Office of the Committee:
19, Marylebone Road, London, N.W.,
Nov. 23, 1898.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.
He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.
Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the Guildford Gas Light and Coke Company, the Directors of the Whitchurch and District (Hants) Gas Company, Limited, the Executors of the late G. E. Wood, Esq., and other Owners.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Tuesday, Jan. 17, 1899, at Two o'clock, in Lots—

GUILDFORD GASLIGHT AND COKE COMPANY (a new issue by order of the Directors).—£5000 of ORDINARY STOCK, ranking for a Standard Dividend of 5 per cent., subject to the Sliding-Scale; the Dividend on similar Stock having been at this rate for several Years past.

WHITCHURCH AND DISTRICT (HANTS) GAS COMPANY, LIMITED (a new issue by order of the Directors).—89 £10 (fully paid) ORDINARY SHARES.

WALTON-ON-THAMES AND WEYBRIDGE GAS COMPANY.—210 £10 "A" SHARES.

ROMFORD GAS & COKE COMPANY, LIMITED.—100 £5 "A" SHARES, and 66 £5 "B" SHARES; and

WORTHING GASLIGHT AND COKE COMPANY.—18 £10 SHARES, 7 per cent. class.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

ENRICH YOUR GAS
WITH
CHEAP BENZOL.
AT to-day's Price of Benzol, Illuminating POWER costs less than ONE-THIRD OF A PENNY PER CANDLE.
Apply to SADLER & CO., MIDDLESBROUGH.

TUBES AND FITTINGS
ALL KINDS
WRITE FOR PRICES
STAFFORDSHIRE TUBE Co., BIRMINGHAM.

HEBBURN MAIN GAS COALS.
Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.
For Prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

THE Acetylene Illuminating Company, Limited, 63, Queen Victoria Street, London, E.C., GIVE NOTICE that they hold the BRITISH PATENT RIGHTS for the MANUFACTURE OF CALCIUM CARBIDE by means of the electric furnace, that they are bringing an action against the Midland Acetylene (Parent) Syndicate, Limited, to restrain them from so manufacturing that product, and that they intend in the future to bring actions against all infringers of these Patents and all purchasers or users of Carbide of Calcium made in infringement of the same.

THE
ACETYLENE ILLUMINATING COMPANY, LTD.,
Manufacturers of Carbide of Calcium,
63, QUEEN VICTORIA STREET, LONDON, E.C.,
and FOYERS, SCOTLAND.

NOTICE.

MESSRS. Read Holliday & Sons, Ltd., of Huddersfield, and Messrs. Tinker, Holliday, & Co., Limited, of Hazelhead, Sheffield, having advertised that they are Manufacturers of Carbide of Calcium, and having guaranteed to indemnify anyone who buys Carbide from them, against any claim by the Acetylene Illuminating Company, Limited, Notice is Hereby Given by the Acetylene Illuminating Company, Limited, that they have been unable to secure any evidence, and do not believe, that either of the said Firms is, a Manufacturer of Carbide of Calcium.

The Acetylene Illuminating Company, Limited, for over two years, have been supplying Carbide to Messrs. Read Holliday & Sons. This Firm has, since advertising as above mentioned, ordered a further supply, which order the Acetylene Illuminating Company, Limited, have declined to execute in view of such advertisement.

On the Acetylene Illuminating Company, Limited, securing evidence that either of the above Firms, or any other Person or Firms are manufacturing or importing Carbide of Calcium, they will bring an action for Infringement of their Patent Rights.

LONDONDERRY GAS COALS
FROM THE
MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.
Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO
S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

NOW READY.

Foolscap 4to, pp. 535, with 239 Illustrations and Steel Plate Engraving (as Frontispiece) of WILLIAM MURDOCH, *Inventor of Gas Lighting. Morocco Gilt, 21s.; Roan Gilt, 18s.*

THE SIXTH (AND CENTENARY) EDITION
OF THE
HANDBOOK
FOR
GAS ENGINEERS AND MANAGERS.
BY
THOMAS NEWBIGGING,
M.Inst.C.E.

This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions. Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry. About fifty additional Illustrations are given; and a Steel-Plate Engraving of William Murdoch, the Inventor of Gas Lighting.

PRINCIPAL CONTENTS.

Introduction; Chief Kinds of Coal; Analyses of Coals and Cannels; Storage of Coal; Spontaneous Ignition of Coal; Gases Occluded in Coal; Testing of Coal for its Producing Qualities; Gas Production; Retort-House; Inclined or Sloping Retorts; Retort-Stack; Retorts; Retort-Settings; Regenerative System of Heating Retorts; Flues and Draught; Analysis of Furnace Gases; Retort-Bench Mountings; Hydrocarbon and other Gases and Vapours; Retort-House Too's and Appliances; Machine Charging and Drawing; Condensation; Naphthalene; Condensers; Exhausters; Steam Engines and Boilers; Washers; Tower Scrubbers; Washer-Scrubbers; Bye-Pass Mains and Valves; Tar and Liquor Wells and Tanks; Purification; Purifying-House; Purifiers; Limestones and Lime Burning; Station Meter and other Indicating and Recording Apparatus; Gasholder Tanks; Gasholders; Governors; Main-Pipes; Main-Pipe Joints; Wrought-Iron and Steel Main-Pipes; Laying of Main-Pipes; Discharge of Gas through Main-Pipes; Service-Pipes and Fittings; Public Lighting; Consumers' Gas-Meters; Testing-Meters; Internal Fittings; Gas Testing Appliances and Methods; Tests for Impurities; Illuminating Power; The Aerorthometer; Foreign and other (proposed) Home Standards of Light; Jet Photometers; Specific Gravity of Gas; Enrichment of Coal Gas; Public Illuminations; Coloured Fires; Illumination Devices; Use of Gas for Purposes other than Lighting; Residual Products; Coal Tar; Ammoniacal Liquor; Sulphur Recovery; Coal Products; Elementary Substances; Chemical and other Memoranda; The Gas Industry; Cost of Gas-Works; Miscellaneous; Bricks and Brickwork; Mortar and Concrete; Iron, Steel, and other Metals; Velocity and Force of the Wind; Office Memoranda; Epitome of Mensuration; Arithmetical and Algebraical Signs; Multipliers; Table of Diameters, Circumferences, Areas of Circles and Sides of Equal Squares; Weights and Measures; French Weights and Measures—Decimal System; Money Tables.

LONDON:
WALTER KING, 11, BOLT COURT,
FLEET STREET, E.C.

UNEQUALLED.
Gas Companies are solicited to try Samples
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

HEATHCOTE GAS COAL.
Rich in Illuminating Power and Yield of Gas.
Above the Average in Weight and Quality of Coke.
Maintains a High Standard in Residuals.
THE GRASSMOOR CO., LD.
CHESTERFIELD.

BOLDON GAS COALS.

ANALYSIS.

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

For Prices, &c., apply to
W. H. PARKINSON,
THE HARTON COAL CO., LTD.,
NEWCASTLE-ON-TYNE.
Telegraphic Address: "PARKINSON NEWCASTLE."

WELDON MUD
FOR
GAS PURIFICATION,
For use in the
RECOVERY OF SULPHUR,
ALSO
Removal of last Traces of SULPHURETTED HYDROGEN in catch position.
Full Particulars on application to the Patentees:
GAS DESULPHURIZATION CO.,
— LIMITED, —
1, FENCHURCH AVENUE, LONDON, E.C.

THORNLEY GAS COALS
WORKED BY THE
WEARDALE IRON & COAL CO., LD.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton	10,500 Cub. Ft.
Illuminating Power	16·9 Candles.
Coke (of good quality)	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·78 ,,

For Price, &c., apply to the
WEARDALE IRON & COAL CO., LD.
QUAYSIDE, NEWCASTLE-ON-TYNE.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LONDON OFFICE: R. CULL, 34, OLD BROAD ST., E.C.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY.

LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH, N.B.

HOLMSIDE

GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . . 11,205 Cubic Feet.
Illuminating Power $16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality) $13\frac{3}{4}$ Cwt. per Ton.
Sulphur . . . . . A little over 1 per Cent.
Ash . . . . . Under 1 per Cent.
Tar . . . . . 163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor 103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR

PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,

HOLMSIDE & SOUTH MOOR OFFICES, NEWCASTLE-UPON-TYNE.

EVESON FOR CANNEL

TELEGRAMS: "EVESON, BIRMINGHAM."

THOMAS DUXBURY & CO.,

16, DEANSGATE, MANCHESTER.

Best Gas Coal and Cannel, giving High Illuminating Power, Large Yield per ton, and reasonable in Price.

Telegrams: "DARWINIAN, MANCHESTER." Telephone 1806.

INCANDESCENT GAS LIGHTING.

Incandescent Burners from **5/6 per doz.**

Specially annealed best Fireproof Glass Chimneys (equal to the Jena.) 1/4 per Doz.

All other Incandescent Fittings at greatly reduced Prices.

Best "Comet" Bulbs, 3s. per Dozen.

Write for Illustrated Price Lists.

WHOLESALE FITTINGS COMPANY,

80, COMMERCIAL ROAD, LONDON, E.

INCANDESCENT GAS LIGHTING

Has now gained a complete and final **Victory** over its last and greatest Enemy

VIBRATION,

BY MEANS OF

CLAY'S PATENT

SHOCK-PROOF

Incandescent Burner Fittings

Of which full Particulars may be had from

CLAY & WALMSLEY,

BOLTON, ENGLAND.

Telegrams: "CLAYS, BOLTON."

See "JOURNAL OF GAS LIGHTING," July 7, 1896, p. 19, and Dec. 21, 1897, p. 1365.

London Representatives: H. Greene & Sons, Ltd. 19, Farringdon Road.

JAMES OAKES & CO.

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, $1\frac{1}{2}$ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts and Covers, and rendering Leakage impossible.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,

for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 17·8 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,

COAL OWNERS, NEWCASTLE-ON-TYNE

OR

E. FOSTER & CO.,

21, JOHN STREET, ADELPHI, LONDON, W.C.

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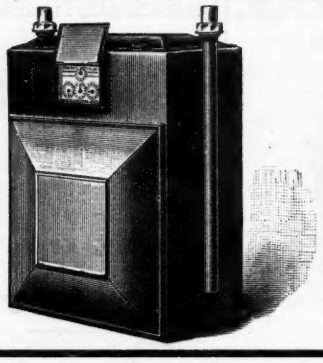

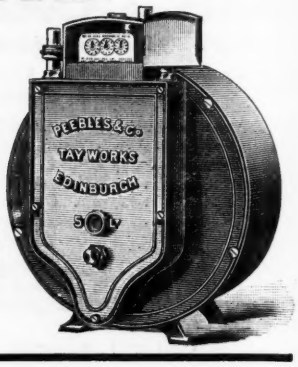

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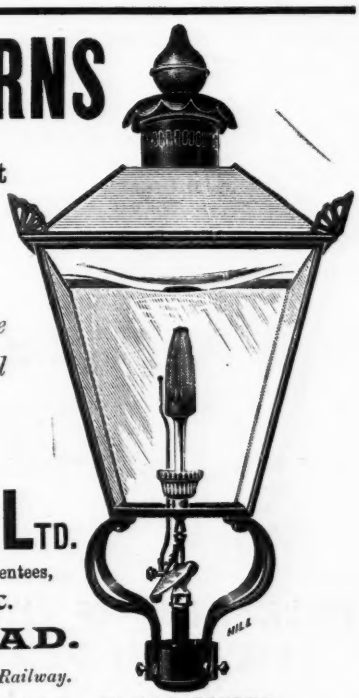

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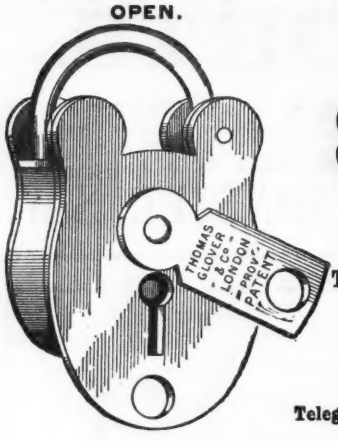

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Prevents Tampering with the

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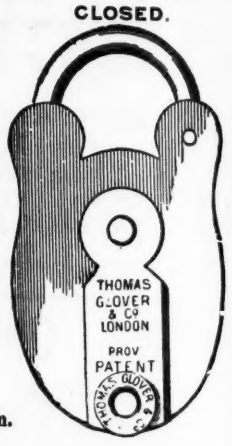

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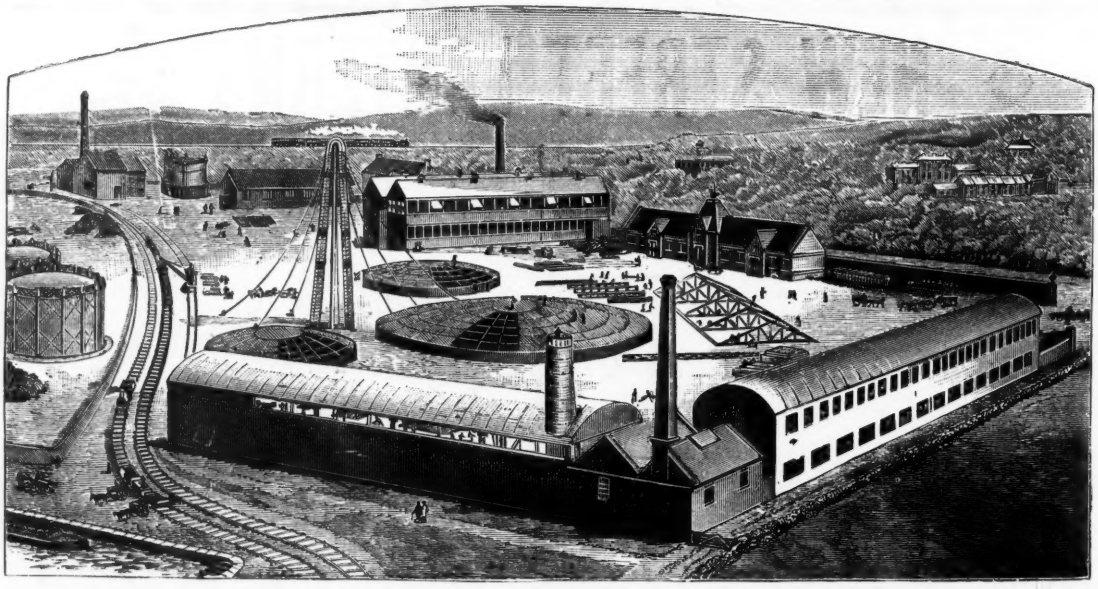

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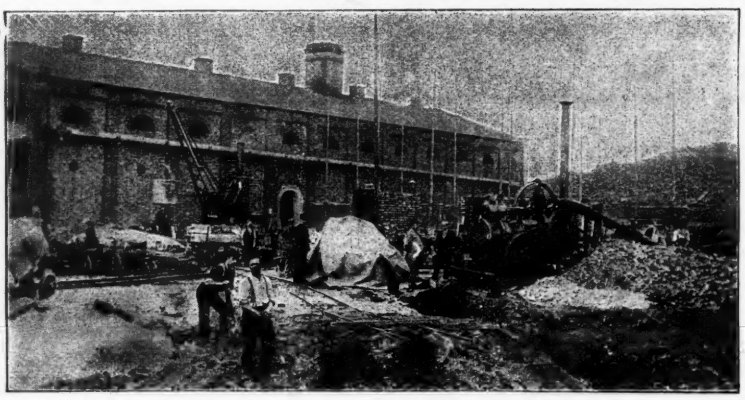

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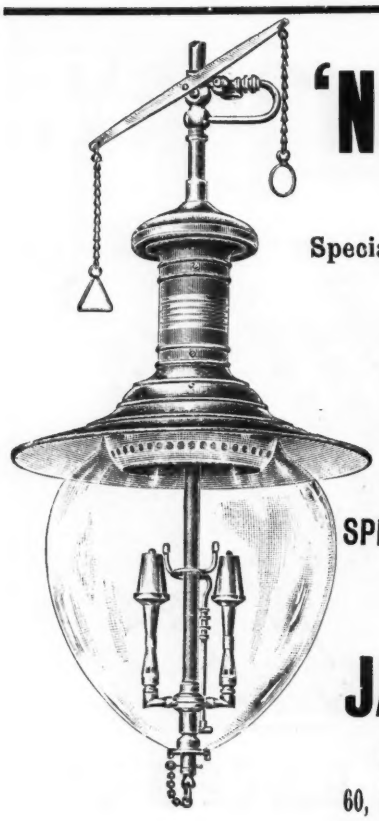

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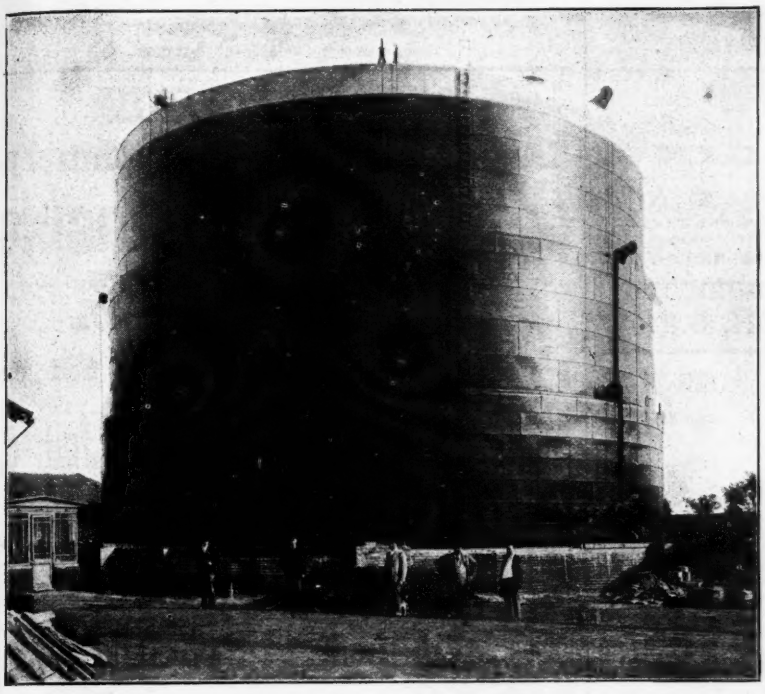

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SLIGO	50 ft. by 18 ft.,	3 ,,
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SVENDBORG	46 ft. by 19 ft.,	2 ,,
VALPARAISO	80 ft. by 24 ft.,	2 ,,
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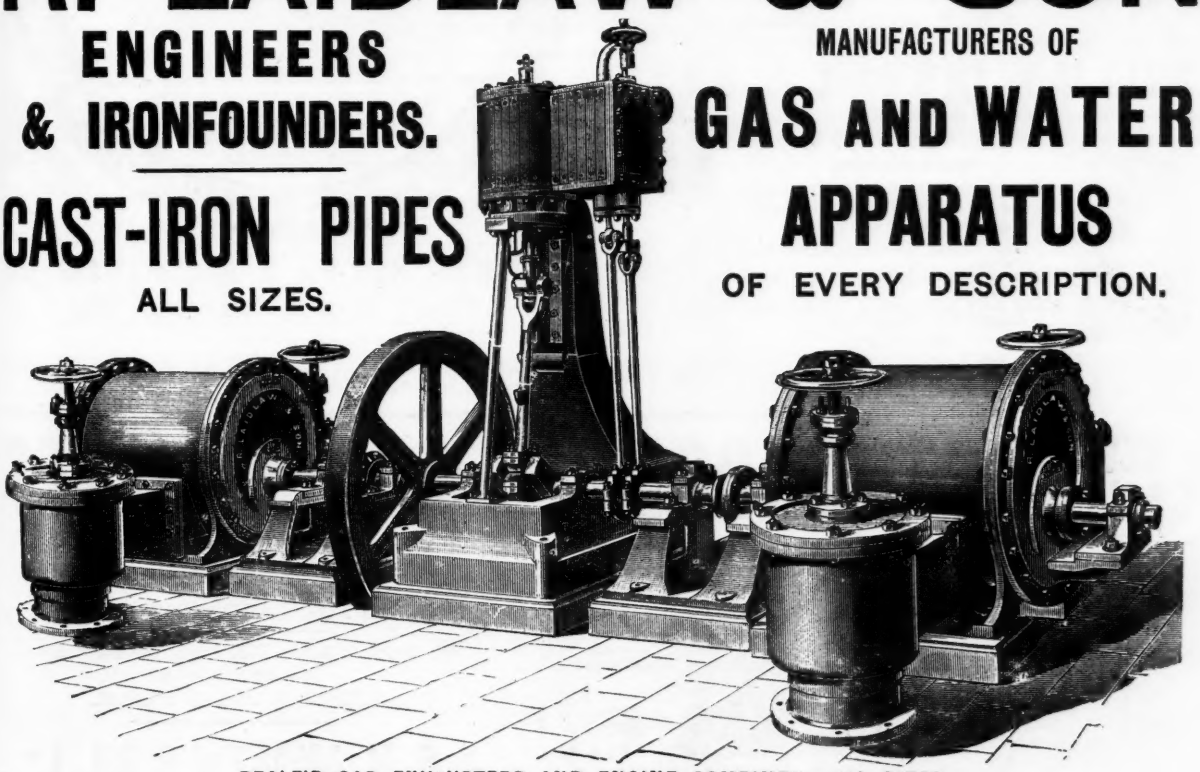

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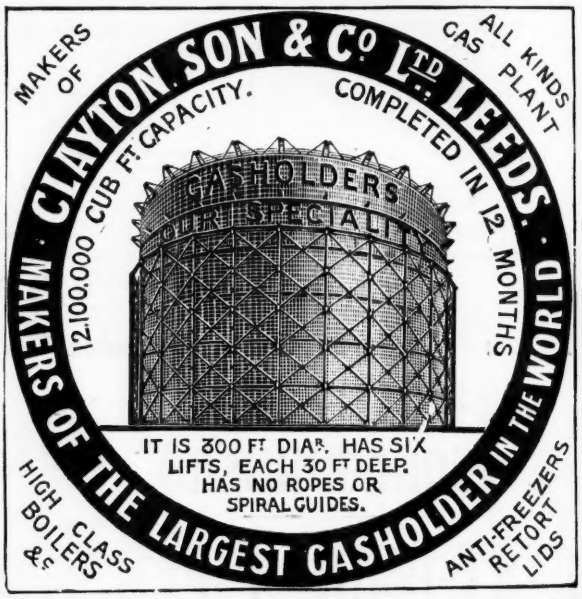
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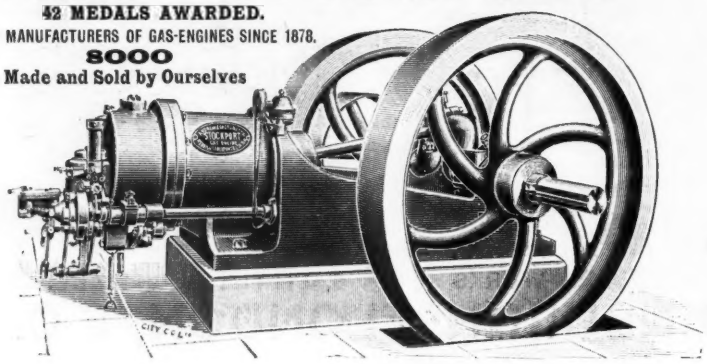

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RETORTS CAREFULLY PACKED FOR EXPORT.
Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

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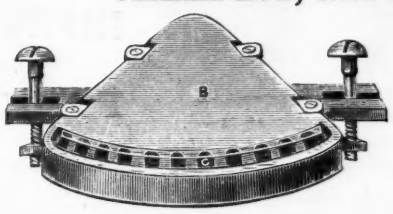
GAS-FIRES
ARE THE
MOST ECONOMICAL, SIMPLEST, CHEAPEST, and BEST.



They are easily fixed to any ordinary Grate. The shapes correspond with the bottom of the grate. Hence the current of air passes from the front to the back of the fire, heating the fuel throughout.

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Water-Cooled Condensers
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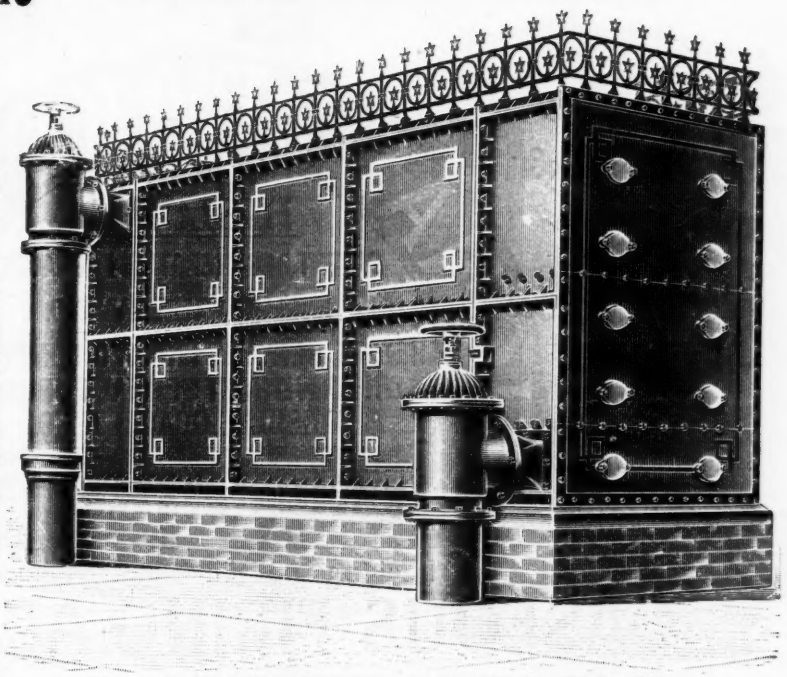
This water-cooled Gas Condenser is designed to work against the great variations of temperature between day and night, sunshine and shade, summer and winter, which are found in this and other countries.

Water being the cooling medium, the temperature of the gas can be kept under control better than with air; and the gas can be sent forward to the purifying plant at the proper temperature for efficient and economical purification.

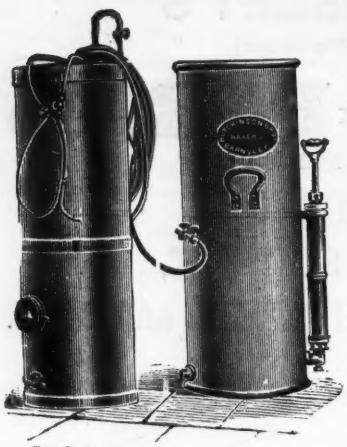
The cold water enters at the bottom, and gradually rises to the top as the water absorbs heat, thus causing the warm gas to meet the warm water first, and to leave the Condenser in contact with water at any desired temperature by simply regulating the feed-water tap. The gas is thus **cooled progressively, uniformly, and effectually.** The simple construction of this Condenser affords a large cubical capacity, so that the gas remains in a considerable time, and secures all the advantage due to slow-speed condensation. Every part of the Condenser is easily accessible, and by removing the end plates the whole of the interior can be got at. It can be erected under cover, and protected from extremes of heat or cold.

R. & J. DEMPSTER, LTD., recommend this Condenser to be used as a Finishing Condenser, after the gas has already passed through the ordinary Annular or Air Condensers.

Condensers of this type equal to 10,500,000 cubic feet per 24 hours already erected and at work.



From a Photograph of Condenser erected at the Gas-Works, Widnes.
Capacity 1,500,000 cubic feet per 24 hours.



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IMPROVED LEAD-BURNING APPARATUS.

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LEAD WORK FOR SULPHATE OF AMMONIA PLANTS.

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SATURATORS, all Lead, or Strong Sheet Lead, in Wood Casing,

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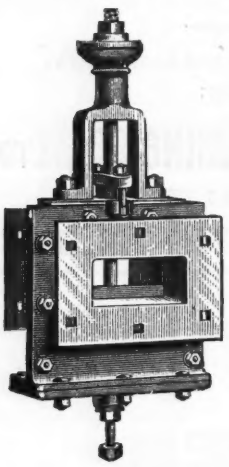

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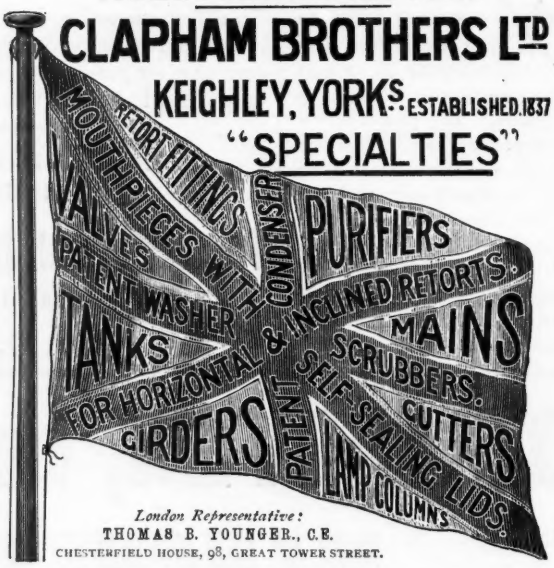

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